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Grassroots Conservation of Biological Diversity in the United States

Background Paper #1

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Grassroots Conservation of Biological Diversity in the United States

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Preface

In recent years an increasing number of individuals and citizen-based groups in the United States have undertaken activities that contribute to the maintenance of biological diversity. While many do not define their activities in these terms, their contributions—through activities devoted to conservation of ecosystems, wild species, and agricultural crops and livestock—have had significant beneficial impact. Although grassroots efforts are not likely to replace public or national efforts, they form an integral part in the Nation's efforts to maintain biological diversity. They, however, can accomplish some activities unlikely to be undertaken by government agencies and large national conservation organizations. These individuals and groups commonly have a number of constraints that can limit their effectiveness. This background paper examines the contributions of grassroots organizations and individuals by illustrating the diversity and range of efforts and indicating, where possible, the present and potential impacts of these activities on the overall effort to maintain biological diversity.

This paper is part of the Office of Technology Assessment's forthcoming assessment of *Technologies To Maintain Biological Diversity*. A concurrent background paper, *Assessing Biological Diversity in the United States: Data Considerations*, examines the technological and institutional aspects of biological data relevant to maintaining biological diversity in the United States focusing primarily on Federal data collection efforts. This assessment was prepared by OTA in response to requests from the House Committee on Science and Technology, Senate Committee on Foreign Relations, and the Senate Committee on Agriculture, Nutrition, and Forestry, and supported by the House Committee on Foreign Affairs, House Committee on Merchant Marine and Fisheries, and the House Committee on Agriculture.

OTA wishes to thank and acknowledge the participants of the grassroots workshop, the advisory panel, authors of the four OTA commissioned papers on grassroots activities, and a number of other individuals who provided helpful materials and reviews to the OTA staff. In addition, OTA is grateful for the support, assistance, and cooperation of the various groups and individuals working to maintain biological diversity in the United States and described herein.

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Chapter 1
Introduction

Chapter 1
Introduction

> Individuals in every generation must decide what they will preserve for those who follow. Some hope to leave fortunes, homes, or works of art. Others want to pass on peace, freedom, or religious faith. Today, growing numbers of people are trying simply to save the other living things that populate our planet. They want their children to know whooping cranes and blue whales, Esopus Spitzenburg apples and Hopi blue corn (33).

The human species has the dubious distinction of being able to modify and manipulate its habitat and that of other species that share it more profoundly than any other taxon. Notwithstanding, humans remain inextricably linked to the natural world. We rely on it for food, fiber, and other vital products such as medicines and pharmaceuticals (39,47). In addition, these ecosystems govern, support, or strongly moderate essential ecological processes such as moderating climate; concentrating, fixing, and recycling nutrients; producing and preserving soils; controlling pests and diseases; and degrading wastes and pollutants (18,55,78). Finally, natural systems and their component species provide humans with esthetic pleasure, emotional well-being, and spiritual enlightenment (17,57). Though these contributions are more difficult to measure, they are no less noteworthy.

In recent years, there has been a growing concern over an accelerating loss of biological diversity on the planet. Biological diversity is the variety and variability within and among living organisms and the ecological complexes in which they occur. Biological diversity is indispensable to the ecological processes described above. It supplies raw materials and ideas for scientific and technical advancement. Genetic diversity is basic to the breeding programs which protect and improve cultivated plants and domesticated animals. For these reasons, the maintenance of biological diversity is generally perceived as both a matter of insurance and investment as well as a matter of moral principle (31).

IMPORTANCE OF AND MOTIVATIONS FOR GRASSROOTS ACTIVITIES

The benefits from maintaining biological diversity such as improvements in agriculture and the ecological processes that support life accrue to all individuals though they seldom pay for them. The public nature of these benefits makes it impossible for the private sector to assume full responsibility for protecting biological diversity. Private commercial interests maintain a limited amount of diversity by preserving germplasm from some commercially important plants, animals, or micro-organisms. Other private citizens also have assumed responsibility for maintaining biological diversity. They preserve anything from a particular breed of livestock to an entire ecosystem for personal reasons, but their contributions cannot be expected to cover the broad range of species and ecosystems which biological diversity encompasses.

The major responsibility for maintaining biological diversity in the United States, therefore, falls on the public sector. The national network of forests, parks, refuges, and related protected areas comprise some 400 million acres. The Federal Government, through the National Plant Germplasm System (NPGS), also has responsibility for collecting, storing, and disseminating germplasm of agricultural crop species.

Nonetheless, private sector activities—e.g., those described in this report—complement Government efforts in important ways. The activities of some individuals or groups may

backup national programs and, thus, reduce vulnerability through duplication of those efforts. In other cases, private activities maintain biological diversity in ways that the public sector does not, cannot, or will not. The range in scope and effectiveness, as well as the sheer numbers of activities undertaken by private individuals and groups make it difficult to measure, in any quantitative sense, the full extent of grassroots contributions.

There are many reasons why people conserve biological resources. Some people collect diverse kinds of livestock, seeds, or wildflowers for reasons similar to those who collect stamps, coins, matchbooks, baseball cards, or seashells. Although their activities result in the preservation of biological diversity, this may not be the stated goal. Other people want to preserve a simpler or older way of life. The strength of this motive is evident in the proliferation of "living historical farms" where plants and animals typical of an earlier era are seen in their original settings. For many, the determination to preserve a personal heritage leads to a larger work preserving biological diversity.

Conservation is linked to a religious or cultural heritage in some communities. Mormons, Mennonites, Hispanic, and native Americans have persisted in local exchange and preservation of seed and livestock which generally are not commercially available (26,41). The fields and gardens of native American communities, for example, are considered one of the richest potential sources of genetic resources in the United States (41,75).

Groups can be driven by concern for environmental integrity. Members of such organizations frequently champion organisms or environments which might be overlooked by the broad mandates of a government agency or call attention to perceived consequences of threatening developmental activities. Groups may also emerge to integrate, support, or challenge the varied and sometimes conflicting goals of government agencies that administer large tracts of public lands.

Although the contributions of many grassroots groups to the maintenance of biological diversity are a consequence of other complimentary activities, some are motivated by a desire to maintain the diversity of life forms per se. Some individuals or groups begin with this focus, others evolve into it as they become aware of the biological diversity issue. Their efforts span the full range of on-site and off-site activities and from individual species to ecosystems.

SCOPE OF BACKGROUND PAPER

This Office of Technology Assessment (OTA) background paper was prepared in support of a broader study which will identify available and emerging technologies to maintain biological diversity. In assessing national efforts to maintain biological diversity, emphasis inevitably is placed on large government programs and agencies responsible for preserving the Nation's natural heritage. When nongovernmental efforts are examined, attention is almost exclusively focused on large environmental organizations such as the National Audubon Society, the National Wildlife Federation, The Nature Conservancy, and the Sierra Club. While these groups play a vital role in maintaining biological diversity in the United States, their high visibility often overshadows the important contributions of a more dispersed

sector—those individuals and small groups not affiliated with large national or public institutions.

For the purposes of this background paper, these contributions will be referred to as "grassroots activities." For the most part, these activities are undertaken by individuals or groups whose essential focus and base of support are local and regional. They do not include government agencies, intergovernmental coordinating councils or government-appointed advisory commissions, diploma or degree-granting educational institutions, or private research institutions.

Grassroots groups vary in size, professionalism, permanence, and affiliation. They range from individual efforts or small, ad hoc collections of amateurs that operate independent of any larger body to sizable, long-established organizations staffed by professionals and affiliated with national organizations. Their activities may include maintaining an obscure breed of horses, maintaining a diversity of heirloom vegetables, or acquiring and managing natural areas.

The bulk of this background paper highlights and assesses specific "showcase" examples of grassroots individuals and groups maintaining biological diversity in the United States. A concluding section elucidates the major issues that stem from their activities. The individuals and groups were chosen to represent a range in scope, size, and geographic location. Their actions differ significantly in ideology; methodology and style; willingness and ability to coordinate their activities with government agencies, national organizations or other grassroots efforts; level and security of financial support; stability and longevity; and level of professionalism and access to talent (43).

Chapter 2

Representative Groups

Chapter 2

Representative Groups

In the United States, there is a very large number of groups and individuals preserving biological diversity at the grassroots level. The following showcase examples were selected with the realization that numerous groups exist which would provide equally suitable examples. This report is not intended to rank these groups above others but to display the range of activities and contributions of such groups and individuals to the maintenance of biological diversity.

Synopsis of Groups Highlighted in This Background Paper

Grassroots group: Major activities	Page number
Abundant Life Seed Foundation: Regional seed exchange in the Pacific Northwest	38
American Cream Draft Horse Association: Registering, certifying, and promoting a single breed of livestock	44
American Minor Breeds Conservancy: Coordinating conservation activities for rare domestic breeds of livestock	44
Center for Plant Conservation: Coordinating preservation activities of 18 U.S. botanical gardens and arboreta	27
Desert Botanical Gardens: Maintaining, researching, and displaying common and rare desert plants	26
Desert Fishes Council: Preserving species and habitats of fishes in arid regions of the Southwest	16
Desert Tortoise Preserve Committee: Conserving the Desert Tortoise through establishment of a 38-acre tortoise preserve	12
Florida Audubon Society: Regional society engaged in a broad range of ecosystem and species conservation activities	22
Greater Yellowstone Coalition: Advocacy group and coordinating body for groups concerned with preserving the Greater Yellowstone ecosystem	18
Individuals, agricultural animals: Maintaining and breeding one to several minor breeds of livestock	42
Individuals, American Federation of Aviculture: Organization serving individuals engaged in the keeping and breeding of nonnative birds	31
Land Trust Exchange: Providing legal and technical support to land preservation groups	13
Living Historical Farms: Recreating and interpreting historic agricultural settings	39
Native Seeds/SEARCH: Collecting, preserving, and disseminating native crops and their wild relatives of the Southwest	39
North American Fruit Explorers: Exploring, maintaining, and exchanging information on fruit and nut varieties	37
Prairie Preservation Society of Ogle County: Preserving an 11-acre tall grass prairie site in Illinois	10
Rhododendron Species Foundation: Collecting, preserving, and propagating wild species of Rhododendron	24
Seed Savers Exchange: Preserving heirloom and endangered commercial varieties of garden vegetables	35
Southeast Alaska Conservation Council: Advocacy group and coordinating body for groups concerned with management of the Tongass National Forest	20
Texas game ranchers: Maintaining and breeding large, nonnative mammal species	32
Wildlife Education Program for a Living Future: Environmental education with emphasis on human/predator interactions	15

SPECIES AND ECOSYSTEMS—ON-SITE

Maintaining biological diversity of wild species on-site offers unique advantages over living collections maintained off-site. On-site preservation permits efficient maintenance of far greater species diversity than is possible through off-site methods. With on-site methods, entire communities of species and their diverse habitats can be preserved with the result that natural selection and evolutionary processes continue. In addition, both the known and currently valued as well as unknown and potentially valuable species are maintained. Both on-site and off-site techniques are important components in an integrated program for preservation of all segments of biological diversity (42).

About 40 percent of all lands in the United States are publicly owned. Within this Federal land system, a network of natural areas with various degrees of protection (e.g., national parks, wildlife refuges, marine sanctuaries, wild and scenic rivers, national forests, and wilderness areas) maintains components of biological diversity. These Federal efforts are reinforced by a number of private groups working actively to preserve land and the natural diversity it supports. Some of these groups play a key political role in supporting legislative safeguards protecting natural areas. Others watch over and care for specific areas that might otherwise suffer from neglect, inattention, or shortage of funding. Both the government and the private sector hold land, but private groups do so largely to fill in gaps where the government will not, cannot, or should not (43).

Interested citizens and groups commonly provide information that aids in the administration of government programs. The efforts of concerned citizens and organizations have precipitated government actions at the Federal, State, and local level. Individuals and groups have worked to initiate, modify, or cancel government policies and actions that affect the environment (43). They promote environmental quality in legislative, legal, and administrative arenas and, like the government, function at local, State, interstate, national, and international levels (43).

The actions taken by these organizations range from relatively passive (e.g., commenting on agency proposals) to confrontational (e.g., stopping construction of a dam). Indeed, a few groups consider civil disobedience a valuable tool. In most cases, however, lawsuits in State or Federal courts are the intervention method of choice. Few of these groups explicitly promote the maintenance of biological diversity, yet many of the programs and actions they encourage have direct bearing on it. Environmental advocacy groups often focus, refine, and articulate public needs by providing leadership, information, or organization. They can be sensitive and highly responsive to conditions or situations overlooked by government agencies because they are diverse, local, and adaptable (43,45). They can, in addition, provide an avenue for public comment on particular government proposals, which may effect biological diversity.

The methods of on-site preservation vary and include acquiring land, providing assistance to private landowners or local conservation groups, facilitating communication or concerted action by mediating between large and sometimes competing interests, and environmental advocacy. The following descriptions illustrate the variety of activities and approaches taken by on-site preservation groups.

Prairie Preservation Society of Ogle County

Prairielands are one of the most threatened ecosystems in North America. In Illinois, for example, studies indicate that less than 1 percent of the original tallgrass prairie remains in its native form (30). Prairies have been converted mainly into agricultural production and now support the Wheat Belt and Corn Belt of the Nation's Midwestern States. Many of the remaining vestiges of native prairie appear in old graveyards, along railroad right-of-ways, and as private landholdings. Because these remnants are scattered, Federal consolidation and protection is difficult, and local grassroots organi-

Photo credit: Prairie Preservation Society of Ogle County

Members of the Prairie Preservation Society of Ogle County, Illinois conducting a controlled burning of Bicentennial Prairie as part of their regular management activities for this preserve

zations are attempting to fill this void in Federal ecosystem protection.

One of these organizations is the Prairie Preservation Society of Ogle County, Inc., a land trust of individuals concerned with native prairielands in Illinois. The organization grew from the collaboration of a Soil Conservation Service soil scientist with a local "prairie enthusiast" who also was a prairie nursery owner and prairieland restorer. Their idea was to purchase a remnant prairie parcel to bring recognition to the native prairies in Illinois during the Nation's 1976 Bicentennial Celebration.

The society organized in 1975 as a not-for-profit organization whose purpose was to ". . . engage in or promote charitable, scientific, and educational activities in the fields of natural history and environmental quality protection . . .," particularly relating to local prairie habitats (54). The organization obtained funds from the State Bicentennial Commission with a matching grant from the County for purchase of a local prairie remnant. The organization became fee-title owners of an 11½-acre parcel of native prairie previously held by a private individual in 1980. It was appropriately named Bicentennial Prairie.

Most of the society's 360 members are from Ogle County, Illinois. The governing body, officers, and consultants are all volunteers. Like many nonprofit groups, a core of about 20 individuals does most of the work of the organization, including restoration work on Bicentennial Prairie. Work crews conduct controlled burning operations on the site during the spring to restore the Prairie to pristine condition. They

also cut brush and wood to maintain the prairie habitat. The prairie site is available for scientific and educational projects, and a checklist of plant species on the site has been developed. Many grade-school groups and college classes, as well as individuals, visit the site each year. The society features programs for members on activities and educational opportunities relating to prairie ecosystems.

Because of its success the society has become an organizational model for individuals in other Illinois counties concerned with prairie preservation. Since the Ogle County organization was founded, at least four other county level prairie preservation organizations have become incorporated in Illinois. The society sponsors local prairie workshops in the Midwest, and summaries of the society's work also have been distributed to others in the region.

Finances severely limit the effectiveness of the organization. Membership generates little income because the minimal dues are a one-time-only fee. Local fundraisers are another source of income, since the society's leadership is influential in the community. Labor and materials also are donated. For example, local consultants in prairie ecology and restoration volunteer their technical or ecological expertise. The patchwork of donations has allowed the group to maintain their prairie and prepare a publicly available slide presentation on Illinois' prairies. In the future, they plan to continue the restoration of Bicentennial Prairie, support further educational projects, and perhaps acquire additional remnant prairie habitats along railroad right-of-ways within the county.

Another impediment to the group's effectiveness is the age of the members. At least half the current membership is over 65, and younger members are needed to perform the labor at the prairie site. Perhaps future projects will bring to this organization the commitment of local young people necessary to protect and/or restore many prairie remnants in Ogle County. The Prairie Preservation Society is a showcase example of how local organizations with limited resources can maintain important natural ecosystems by working together to preserve a "piece of their own backyard."

Desert Tortoise Preserve Committee

Less than 25 years ago, it was not uncommon for people living in southern California to take trips through the local desert and return with a newly found family pet—the desert tortoise (*Gopherus agassizii*). A reptile of the deserts of the southwest United States, the tortoise was once common from northwest Mexico to southwest Utah (8). Reports of sightings of several hundred per square mile were not uncommon and populations may have exceeded 2,000 per square mile in some parts of the Mojave Desert (8). The tortoise today can no longer be found in many areas, and its numbers are declining in others.

The desert tortoise is an example of an animal which, though still abundant in a few localities, is declining in others. The species is confined to a narrow range of elevations in the lowland deserts of the Southwest and is particularly sensitive to disturbance of its habitat. Populations are rapidly declining and disappearing in areas of California, Nevada, and Arizona. Only two populations in California remain somewhat intact (9). In September of 1985, the Fish and Wildlife Service (FWS) found that listing the tortoise as an endangered species throughout its range is "warranted, but precluded" by other pending proposals of higher priority (73). Additional data from several areas will be needed before the desert tortoise can be designated as endan-

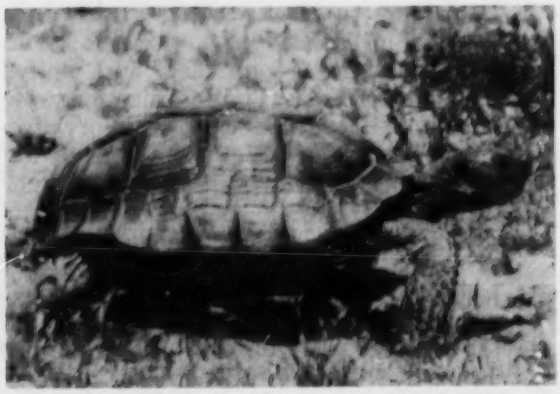


Photo credit: OTA staff

Adult desert tortoise (*Gopherus agassizii*) typical of those found in the Desert Tortoise Research Natural Area, DTNA

gered. Where Federal agencies cannot act to provide protection for locally threatened populations of animals like the tortoise, a grassroots group may be willing and able to do so.

Tortoises are long-lived reptiles (60 to 80 years and over) that do not breed before 12 to 20 years of age in the wild. Once of reproductive age, a female may lay from 2 to 10 ping-pong ball-sized eggs in an excavated nest in late spring. Hatchlings, which emerge from the nest in early fall, are about 2 inches long and very fragile. Less than 5 percent survive to maturity as they are food for numerous desert animals. Vandalism, collection, and habitat deterioration also threaten the tortoise (8).

The Desert Tortoise Preserve Committee was formed in 1974 when several concerned desert residents of southern California banded together with a biologist from the Bureau of Land Management (BLM). Their goal was to work with BLM to establish a preserve for the tortoise on a 31-square-mile parcel of land. Largely as a result of the committee's efforts, the preserve was expanded to 38 square miles in 1976 and remains essentially the same size today. BLM closed the area to off-road vehicles and to sheep grazing in the 1970s. In 1980, BLM formally designated the preserve as the Desert Tortoise Research Natural Area (DTNA) and an area of critical environmental concern. At that time, public lands within the preserve/natural area were officially withdrawn from the general mining laws to protect the habitat from mining.

The Desert Tortoise Preserve Committee is entirely devoted to improving and acquiring land for DTNA and educating the public about the need to protect the tortoise through preservation of its habitat. The committee often lobbies BLM to fulfill its mandated obligations to maintain DTNA since much of the area is under BLM jurisdiction. Portions of DTNA are privately owned, and the committee has raised enough money for The Nature Conservancy to purchase some of those parcels. They have helped BLM exchange land with private landholders in other cases. Funds raised by the committee and a 1976 congressional appropriation to BLM paid for fences around much of DTNA as well as for an interpretive center. The committee also has signed an agreement with BLM to cooperatively manage the natural area.

Funding for the committee has come from sales of various products, including T-shirts and pendants. Contributions also have been received from individuals, turtle and tortoise clubs, garden clubs, and gem and mineral societies, as well as chapters of the Sierra Club and the Audubon Society. The Desert Tortoise Preserve Committee became a Project Committee of The Nature Conservancy in 1976, and much of the money raised since then has gone to The Nature Conservancy for purchase of privately held land within the natural area. About 2.5 square miles of private parcels have been acquired to date and 11 square miles (about 400 parcels) remain.

The Desert Tortoise Preserve Committee devotes considerable effort to monitoring the activities of a Federal agency—BLM—within their area of concern. Further, they are engaged in negotiations to purchase privately held lands within the natural area. The committee is a grassroots group that is addressing a local conservation need and anticipating a more general future decline in the populations of a wild species.

The Land Trust Exchange

Local and regional organizations called land trusts are preserving lands with special natural, scenic, recreational, agricultural, or historic qualities throughout the United States. They maintain trout streams, forests, prairies, farmlands, and historic sites among other things. Of the 500 or more land trusts, some are small, all-volunteer organizations; others are sizable groups with paid professional staffs. Their aggregate membership is estimated at 350,000 individuals (19),[1] and their preservation activities encompass a total of 1.7 million acres of land (table 1).

The Land Trust Exchange was formed in late 1981 by the Brandywine Conservancy in Pennsylvania, Iowa Natural Heritage Foundation,

[1]By comparison, The Nature Conservancy and National Audubon Society have memberships of approximately 200,000 and 500,000, respectively.

Table 1.—Distribution of the Total Acreage Encompassed by the Land Conservation Activities of U.S. Land Trusts

Nature of holdings	Acreage	Percent of total
Owned by purchasing land trust	289,000	17
Conservation easements	448,000	26
Transferred to a third party (e.g., a National Park)	975,000	57

SOURCE: B. Emory, Executive Director, Land Trust Exchange, personal communication, September 1985.

Maine Coast Heritage Trust, and Napa County Land Trust in California. Their purpose was to establish "... a national communication network for local and regional private land conservation groups." They emphasize local and regional preservation of land and water. The list of sponsoring organizations currently exceeds 40, and a growing number of other organizations and individuals are associate members.

The Land Trust Exchange holds no land itself. Rather, they provide assistance and expertise to conservation organizations throughout the United States. They publish a professional journal, *Exchange,* that includes in-depth case studies and articles on conservation techniques, program development and management, and public policy. They also distribute a series of memoranda on Federal tax matters affecting land conservation, a directory of land trusts, and numerous special publications on specific topics. One recent project is a national survey of all government and nonprofit conservation easement programs in the United States. Another is a movie documenting the public benefits of conservation easements which features the Blackfoot River in Montana; Freeport, Maine; and the Chesapeake Bay.

The exchange runs an information exchange service called the Peer Match Program which allows a land trust with a specific problem to obtain low cost consulting help from another land trust which has had a similar problem. The exchange also sponsors meetings and conferences which educate members, address policy issues, and stimulate exchange of ideas and information. A part-time Washington, DC, representative, supported by the exchange, responds to specific political issues affecting land trusts. Finally, the exchange provides opportunities for land trusts to participate in group insurance plans such as Blanket Bonding, Volunteer Accident Coverages, Property Coverages, and various forms of liability insurance necessary for groups which hold land.

The governing body of the Land Trust Exchange is a board of directors, which is elected by the sponsoring organizations (the legal tax status of the exchange is derived from the tax status of their sponsors). The board is deliberately composed of land trust professionals from different parts of the country.

Grants from private, national, charitable foundations, and a few corporations provide approximately two-thirds of the general operating budget of the exchange. The remaining third comes from sales of services as well as individual and group memberships. Sponsoring groups contribute 1 percent of their administrative budget as their membership fee. To ensure that no single group can exercise excessive control over the organization the fee cannot be less than $100, or more than $1,000. Funds for special projects and programs come from foundation grants. The staff includes two full-time and two part-time people in Maine and one part-time person in Washington, DC.

The organization hopes to develop a more stable base of support, founded on greater individual membership and on a larger market for exchange services. Though the exchange has earned a reputation in the conservation community, that constituency has limited funds. Consequently, they are continually seeking opportunities for increased support of their own activities and those of their sponsors.

Political sophistication, particularly about tax law, is essential in the land trust community. Changes in deductions for the value of donated conservation easements have caused difficulties for some groups and individuals. The exchange has addressed this problem through both its Washington representative and publications. The goal of these activities is to provide information to exchange constituents as well as to make the political and conservation community more aware of the valuable role played by land trust groups.

The sole purpose of the Land Trust Exchange is to improve the effectiveness of a segment of the grassroots conservation community. The organization's framework is designed so it can be nationally representative, but locally oriented. By providing technical conservation skills and information to local and regional land trusts, it allows organizations that lack internal expertise to develop their programs in ecosystem conservation efficiently.

Wildlife Education Program for a Living Future

Environmental education is a component of most grassroots activities described in this background paper, but for some groups education is the major thrust of their efforts. Environmental education has been described as:

> . . . the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man, his culture, and his biophysical surrounding (71).

The Environmental Education Act of 1970 was passed by Congress to provide funding in support of environmental education, and represented a national commitment to its importance. Supporting these efforts are a large number of grassroots groups who focus, to varying degrees, on the importance of maintaining biological diversity.

One individual who has taken an active and innovative approach to environmental education is Karlyn Atkinson-Berg, co-founder of the Wildlife Education Program for a Living Future (WEPLF). Karlyn Atkinson-Berg has long been interested in the timber (grey) wolves of northern Minnesota. She created WEPLF in 1973 to bring her knowledge and insights to people of all ages who might not ordinarily be exposed to human-wildlife interactions. Her programs cover not only wolves and wildlife, but also environmental ethics of man's impact on the natural environment.

One of her objectives is to dispel popular myths about predators, particularly the wolf, so her programs demonstrate how predators are an integral part of the natural environment and explain the interrelationships of all species. The programs also explore historic and contemporary attitudes towards nature and discuss how nature is an integral part of our lives.

Ms. Atkinson-Berg uses a wide range of techniques to bring an ecological message to the general public. At one time, she visited schools with a wolf born and raised in captivity to capture the attention of the students. She later stopped this practice, concerned that it detracted from the ecologic content of the program by encouraging her audience to view the wolf as a pet. Presentations with live wolves now are only held at the WEPLF premises in a "wolf woods compound" which does not encourage visitors to view the wolf as a pet. These presentations commonly are accompanied by field trips into the woods for howling and tracking events.

WEPLF also converted a bookmobile into a traveling museum of exhibits and presentations. In addition to an extensive display on the history of the wolf, the museum houses bird nests; animal pelts; skulls, bird, and mammal specimens; and illustrations of ecological cycles in nature. The mobile museum visits schools; civic, social, and service organizations; and even interested individuals. Films, workshops, and slide presentations on wolves, human attitudes, or animal communication are also available.

Ms. Atkinson-Berg works with teachers throughout Minnesota to develop appropriate curricula on nature. She has developed a widely circulated educational packet on the coexistence, competition, and conflict between wolves and humans which she promotes at National Science Teachers Conventions and Environmental Educators Conventions. Ms. Atkinson-Berg feels that this educational package has made an important contribution in presenting a well-rounded picture of the wolf to the public. Rather than designing separate programs, she encourages teachers to integrate consideration of the natural environment and man's interactions with it into other lessons. Through her efforts, information on biological and ecological principles has been incorporated into everyday learning.

The educational programs offered through WEPLF are entirely supported by program fees and donations. Fees are based on travel, time, mileage, and the number of programs offered. Though Ms. Atkinson-Berg hopes to continue adding to the museum with cash or display-item donations, the income from education programs and her other work is meager.

Beyond the problems of limited funding, Ms. Atkinson-Berg believes people may attempt to discredit her because she lacks a doctorate degree (67). In addition, because she has developed a close, personal relationship with timber wolves, critics question her objectivity. Nonetheless, Ms. Atkinson-Berg has won wide recognition for her work. She has served as a consultant on the Science Museum of Minnesota exhibit, "Wolves and Humans" and assisted in the creation of a public television documentary, "Legend of the Wolf." She travels around the country and has appeared on numerous radio and television shows. In fact, her many activities on behalf of wolves have earned her the designation "the wolf lady" (5).

Ms. Atkinson-Berg, since 1978, also has been active in public hearings and litigation involving wolf management, both directly and indirectly by contributing information on wolf behavior and ecology to other environmental groups and attorneys. Although her philosophies and opinions on management practices frequently are in conflict with those of other local residents and government officials, her presentations and dedication have earned her a high degree of respect, even from some who disagree with her approaches.

Despite real or perceived limitations, Ms. Atkinson-Berg has raised the environmental consciousness of many people in Minnesota and across the Nation, by making an active effort to reach many different people with her knowledge about wolves and the importance of a balanced environment. Her programs help people understand that predators are not creatures to be eradicated but a necessary part of the natural world. Her efforts may reduce destruction of natural predators in Minnesota and elsewhere, helping to maintain these elements of biological diversity.

Desert Fishes Council

The native fishes of the American deserts are increasingly threatened by the impacts of man. The survival of many native fish species depends on adequate water in the springs or water drainages of this arid environment. Yet development in the deserts of the Southwest has endangered several species of native fishes by blocking streams and rivers with dams, draining marshes, eliminating native vegetation along water courses, depleting groundwater supplies, and causing silt deposition in fragile habitats (52). Native fish also are threatened by the introduction of game fish, which displace or devour them (52).

Human activities in the Southwest desert have caused the loss of habitat for many native fishes, resulting in extinction for as many as a dozen species (51). Up to 50 other species and subspecies are considered threatened by the Federal Office of Endangered Species or other Federal and State agencies.

Growing concern about the overall decline in desert fish populations, particularly the Devil's Hole pupfish, led a group of individuals to hold a conference in 1969 and establish a Pupfish Task Force. At their second symposium in 1970, 82 scientists, resource managers, and other interested individuals formed the Desert Fishes Council. The council's present membership of nearly 400 includes scientists and researchers from Federal and State agencies, universities, representatives of conservation organizations, and other interested citizens.

The Desert Fishes Council engages in intensive efforts to preserve desert aquatic communities and their associated life forms. Council members conduct research projects to determine the best management strategies for particular species. They help local fish populations recover by manually rebuilding stream areas and reintroducing native stocks into them. The council lobbies on behalf of desert fish habitat with Federal and State agencies which make decisions on land and water use, particularly when those decisions would divert water from streams or springs where native fish are found.

Photo credit: Louis Myers, Bureau of Land Management

Jackrabbit Spring in the Ash Meadows Conservation Area as it appears today and before the installation of an irrigation pump in 1970 by a private landowner

Photo credit: D.W. Sada, U.S. Fish and Wildlife Service

Jackrabbit Spring after installation of the irrigation pump. The Desert Fishes Council has been instrumental in bringing about FWS acquisition and restoration of Ash Meadows. The council has reintroduced two FWS endangered fish species to this spring, the Ash Meadows Amargosa pupfish, *Rhinichthys osculus nevadensis*, and the Ash Meadows speckled dace, *Cyprinodon nevadensis mionectes*

The extensive labors of the membership have resulted in several successes. For example, the council worked with Federal and State officials to protect the spring habitat of the Devil's Hole pupfish by reducing pumping that was depleting underground water in the area. Because of this action, coupled with reintroductions and creation of some artificial habitats, the fish population appears to be slowly recovering (53). Other successes include the protection of Fish Slough in eastern California and Ash Meadows in western Nevada, both important fish habitats which represent unique clusterings of plant and animal species.

In addition to field research and conservation efforts, the council conducts annual symposia on desert fish species and related problems. Publications and other educational materials also are available through the council, and individual members publish articles concerning desert fishes in professional journals.

The success and strength of the council appears to lie in its scientific and technical expertise. When information is needed on individual populations, the knowledge usually can be found among the council members. Though the group has maintained a high degree of participation among its members, it remains small and flexibile enough to focus its attentions quickly and effectively where the need is greatest. One recent editorial on the Devil's Hole pupfish, described the Desert Fishes Council as ". . . a tiny group—but fierce" (3).

Funding for the Desert Fishes Council is minimal. Most of their annual budget of approximately $6,000 comes from the small annual dues and is used primarily to finance its publications. Virtually all other funds come from individual members. The council has never applied for a grant to support its efforts, though members have little doubt that such funds could assist them greatly. When additional funds have been needed, registration fees for their annual symposium were increased slightly. Publications are distributed free to members and at cost to libraries and others.

The survival of this group is largely dependent on the enthusiasm of its leadership and the willingness of its members to donate considerable time, effort, and expertise. A few members, affiliated with government agencies or universities, receive funds for travel to some meetings, but most must travel and work at personal expense. One group member says:

> No doubt we could be more productive with better funding, but a high level of participation from a group of low-income members, many

> of them graduate students, has been the key to our success. We are therefore reluctant to increase dues much beyond the current $10 per year (53).

The Desert Fishes Council illustrates how a grassroots organization with a high level of technical expertise and commitment can be effective in preserving animal species. The issues surrounding desert fishes and their habitats fall under multiple jurisdictions and several Federal and State species protection laws. The council feels they have been particularly effective in an arena where Federal and other agencies are unable or unwilling to move swiftly and efficiently. As a consequence, its efforts contribute significantly to the biological diversity of species, habitats, and ecosystems of the Southwestern deserts.

Greater Yellowstone Coalition

Early in 1872 President Ulysses S. Grant made what has been characterized as a "daring political act" (56) by signing the Yellowstone Park Act (13) which set aside 2.2 million acres as a park to be the "flagship" of the American National Park System (13). The scenic wonders and geologic curiosities of Yellowstone include majestic waterfalls, geysers, forests, wildlife, and historic structures from the early days of the National Park System (13). Today, however, the future of Yellowstone is largely affected by activities and influences from private landholders and national forestlands outside the park's boundaries (13).

Yellowstone National Park is part of the Greater Yellowstone ecosystem, considered by some to be one of the largest essentially intact terrestrial ecosystems in the temperate zone (10). This area covers more than 6 million acres and is governed by more than 25 separate political jurisdictions. Within the ecosystem are two national parks (Yellowstone and Grand Teton), two national wildlife refuges, six national forests, portions of 3 States and 13 counties. Speaking of the Greater Yellowstone ecosystem, William Penn Mott, Jr., Director of the National Park Service, said:

> . . . the time has come to take positive, creative, and forceful steps to set an example of how even with human pressures a total ecosystem can be preserved and managed (38).

The Greater Yellowstone Coalition (GYC) was formed and incorporated in 1983 to coordinate the activities of several national and regional organizations. One of their goals is increased national public awareness of the Greater Yellowstone ecosystem, particularly the special values and legacy of the ecosystem and the multiple risks facing it. The organization articulates the collective concerns of its members and coordinates the actions and activities that stem from those concerns.

GYC proposed national legislation recognizing the Greater Yellowstone ecosystem as a unique entity at its 1984 annual meeting. They want all Federal lands in the ecosystem to be managed to give highest priority to preservation of wildlife habitat and populations. In addition, GYC has been working with the Forest Service as that agency develops forest management plans mandated by the National Forest Management Act (Public Law 94-588). GYC's annual meeting includes scientific sessions in which environmental scientists discuss issues important to conservation within the region. Conservation groups, representatives from Federal agencies and State governments, and Members of Congress have participated in annual meetings.

One of the coalition's first members, the Jackson Hole Alliance for Responsible Planning, works for protection of the scenery, wildlife, and recreation of Jackson Hole, Wyoming. Its 850 members, primarily residents and landowners in the Jackson Hole region, participate in the planning process for public lands such as Grand Teton National Park, the Bridger Teton National Forest, and the National Elk Refuge. Specifically, they want development of private lands in Teton County to be compatible with the preservation of ranching, wildlife habitat, and open space. Through GYC, the Jackson Hole Alliance obtains regional support for the local issues they encounter.

The coalition amplifies the voice and influence of smaller groups within the organization. For example, GYC worked with an ad hoc group known as the Grizzly Caucus to develop a posi-

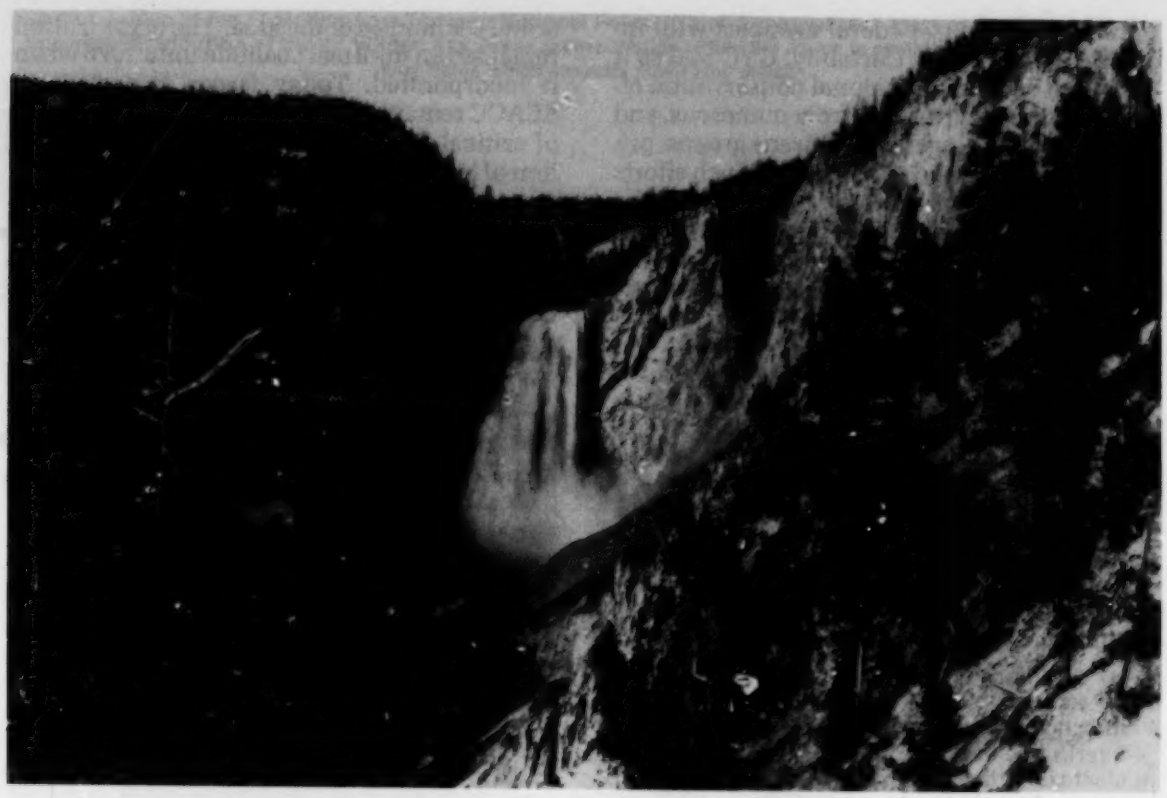


Photo credit: Haynes Foundation Collection, Montana Historical Society, Helena, MT

Lower Yellowstone Falls taken from Red Rock in Yellowstone National Park by F. Jay Hayne, 1899

tion statement on the Grizzly bear (*Ursus arctos*). They later modified the statement to make it applicable to the greater Yellowstone region and then formally adopted it. These actions delineated the concerns of a small group so they could be disseminated to a larger audience.

GYC is administered by a board of 15. Nine of the board members represent the 45 member organizations, 3 are elected by the general membership of approximately 1,000 individuals, and the remaining 3 are chosen by the board itself. This structure keeps the board responsive to the concerns of member organizations. Three paid staff members carry out the coalition's work.

A relatively young organization, GYC receives half its support from foundation grants. Most of the remaining funds come equally from dues and individual donations. Income from sales of a book about the region are modest because the aim is more to educate the public than to raise money. Though private corporations do not provide support at this time, the group plans to approach them and has enlisted the aid of a private marketing firm.

As might be expected, the size of the Greater Yellowstone region makes it difficult to manage GYC programs. Nonetheless, the group unifies its member organizations making it more likely that they will attain their goal—preservation of an intact ecosystem. Their regional approach, if successful, can provide an important model for preserving other broad geographic areas, such as the Chesapeake Bay ecosystem. Although GYC members are vocal about their desire to maximize preservation of the area, they also are making serious efforts to

gain the support of Federal agencies with interests in the region. Certainly, GYC makes it clear that successful regional conservation efforts should include input from numerous, and often competing, agencies, citizens groups, private landholders, and corporations. Such efforts maintain biological diversity by promoting the preservation of species and ecosystems.

Southeast Alaska Conservation Council

> The American people and the residents of Southeast Alaska enjoy a priceless natural resource heritage—our public lands. Our National Forests, National Parks and Monuments, State Forests and State Parks all have one thing in common. They are owned by all of us: each citizen has an equal right to hunt, fish, trap or recreate on these lands. Every citizen has an equal right to speak out and participate in decisions regarding the management of public lands and their resources.
>
> Public lands are managed, in theory, by public servants and agencies who should take direction from the people. In reality, corporate interests continually pressure the public agencies to favor their narrow concerns. Organized citizens bear the burden of reminding our public servants that their responsibility is to the people who live here (59).

This statement from the Citizen's Guide to the Tongass National Forest clearly defines the role of on-site groups concerned with environmental advocacy in general and the Southeast Alaska Conservation Council (SEACC) in particular. SEACC, a nonprofit group, devotes its energies to issues surrounding the management of the Tongass National Forest which covers 17 million acres in southeast Alaska (figure 1). The group reacts to and helps shape management plans and legislation which has a direct bearing on the ecological diversity of the region.

SEACC began in the late 1960s as a loose coalition of environmental groups in southeast Alaska. Its purpose then was to improve communication and cooperation with one another and to address mutual concerns about roads, logging, and mining in that region. The group also wanted to protect the subsistence and traditional economies of the area. The organization remained an informal coalition until 1976 when it incorporated. Today issues important to SEACC remain essentially the same: protection of critical fish and wildlife habitat, preservation of local economies, and multiple-use management of the Tongass National Forest. One of SEACC's products is "A Citizen's Alternative" to the Tongass Land Management Plan of 1979, which proposed protection for 45 sites with unique formations, environments, or stands of old growth forest.

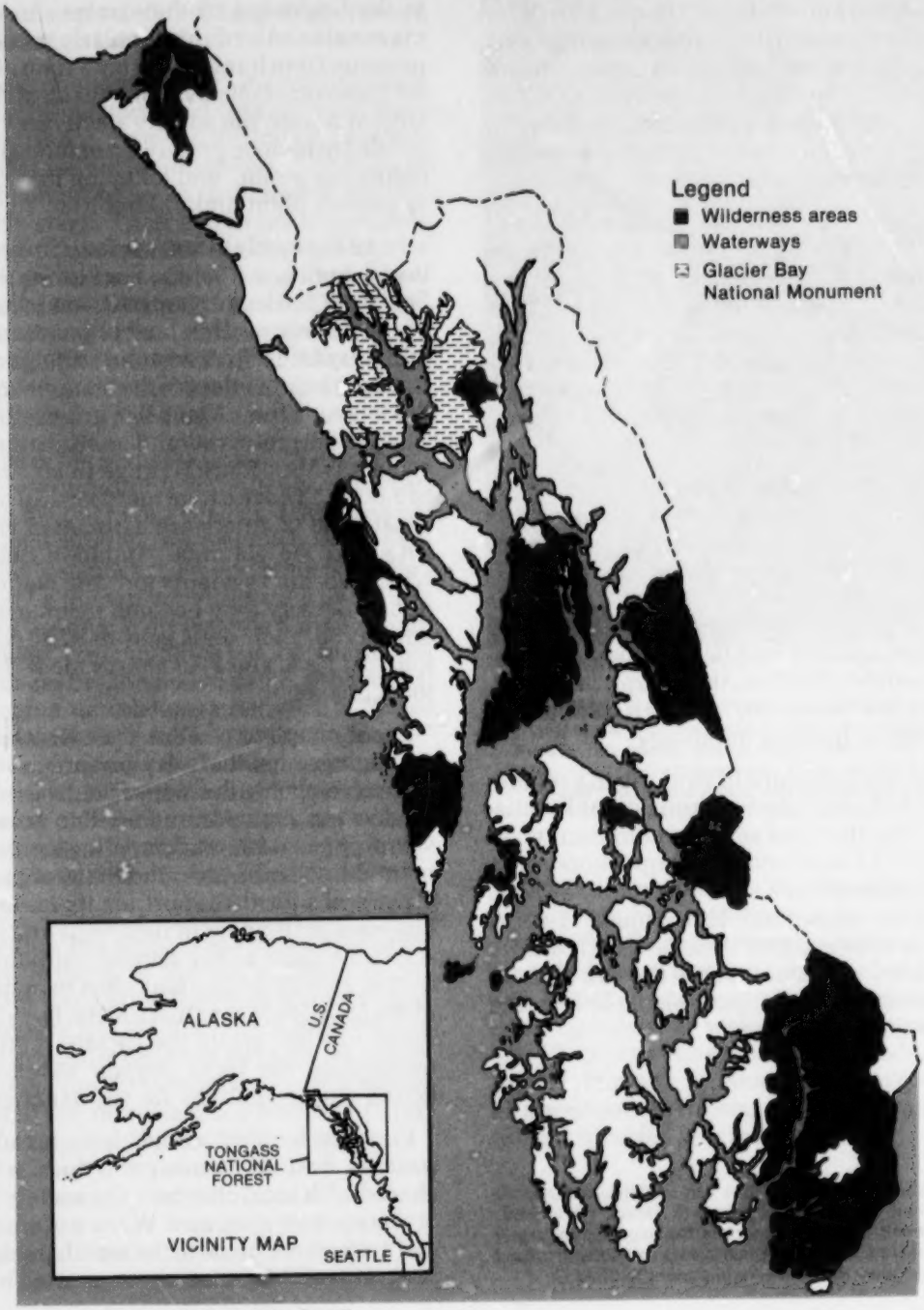
The 1980 passage of the Alaska National Interest Lands Conservation Act (ANILCA) (Public Law 96-487) gave SEACC a stronger voice in the affairs of the Tongass. ANILCA requires that a report on the status of the Tongass National Forest be prepared in cooperation and consultation with several interested groups including SEACC. Much of the group's efforts have gone into evaluations and alternative management plans for the National Forest.

Presently, SEACC's membership includes approximately 600 individuals and 9 community-based organizations[2] with a total membership of approximately 2,000 (35). The board of directors is composed of a representative from each sponsoring organization and an approximately equal number of at-large representatives. SEACC's paid staff ranges from three to six, depending on the number of special projects (35). The organization provides its member groups, interested individuals, communities, and other parties with information and support on issues of land use and management in the Tongass.

SEACC's funds come from a variety of sources. Membership dues and donations provide the major share of the budget. Member groups are not required to provide any financial support, but all are encouraged to do so, and a few make large donations of $1,000. SEACC raises additional money by selling T-shirts or raffle tickets and by sponsoring an

[2]Lynn Canal Conservation, Juneau Group Sierra Club, Sitka Group Sierra Club, Narrows Conservation Coalition, Sitka Conservation Society, Taku Conservation Society, Tongass Conservation Society, Friends of Glacier Bay, and Wrangell Resource Council.

Figure 1.—Map of the 17-Million-Acre Tongass National Forest Which Encompasses Most of Southeast Alaska, Showing Distribution of the 14 Wilderness Areas (transportation within the region is complicated by the numerous long fjords which separate major land areas)



SOURCE: Southeast Alaska Conservation Council.

annual pledge drive. An important portion of their funding for operational programs and some special projects comes from the Alaska Conservation Foundation.[3] Though SEACC receives some money from national foundations, the time-consuming application process diverts staff efforts from other projects (35). SEACC occasionally receives support from local recreational, fishing, and native interests as well as local businesses.

Operating in the southeast region of Alaska adds to SEACC's costs. Transportation in the region frequently is difficult, very expensive, and subject to unpredictable weather. Telephone, rent, and supplies all are more expensive than in other regions of the country. Periodic visits to Washington, DC, to participate in congressional hearings or agency reviews also are a significant expense.

SEACC's location also makes communications a major problem, both inside and outside the region. Within Alaska, geography and climate complicate communications between member individuals and organizations. Groups in remote, rugged areas frequently are isolated by adverse weather and lack of adequate telephone facilities. Further, the group's lack of exposure in the "lower 48," makes it difficult for them to get a hearing nationally.

Despite the hardships of working in a remote area, SEACC staff derives considerable satisfaction from the "real sense of community" in the region. As an advocacy group whose interests are centered on a specific region, SEACC provides an important link among diverse groups in southeastern Alaska which allows them to have a greater voice in development of legislation and future management plans for the Tongass National Forest.

[3]Alaska Conservation Foundation was established to provide funding to four environmental groups in Alaska. While funds provided are only a portion of their total funding, they are largely for general operations, a budget item that is often difficult to fund (35). In this respect they are very important to SEACC.

Florida Audubon Society

The National Audubon Society was formed at the beginning of this century to conserve mammals and birds, particularly species under pressure from hunters. Today as one of the largest grassroots conservation organizations in the United States, the society's activities have expanded to include preserving natural areas, educating the public, and lobbying for legislation to protect plant and animal life.

In 1900, shortly before the founding of the National Audubon Society, the Florida Audubon Society (FAS) was organized to end destruction of the State's wading bird populations by the millinery trade. FAS was and remains administratively independent of the National Audubon Society and their focus has grown to include ecosystems preservation. The 46 chapters of the society within Florida range in size from 100 to 3,000 and have a total membership of 35,000. Most local chapters are associated with both FAS and the National Audubon Society, so when Florida residents join the National Audubon Society they become members in FAS and part of their dues goes to it. Some people join just FAS, and FAS shares those dues with local chapters.

Local chapters of FAS are essentially independent groups that vary not only in size but in involvement with environmental issues. They receive assistance from the State group in developing programs and pursuing local environmental issues. In turn, the State organization often seeks local support for its issues. Local chapters participate in field trips and national activities such as the annual Christmas Bird Count. A chapter also may elect to manage one of the 38 wildlife sanctuaries that have been donated to FAS. While the society retains legal ownership, the local chapter assumes caretaking responsibilities for the sanctuary.

Funding for FAS comes from a number of sources. Besides membership dues, which are shared with local chapters, the society has several corporate sponsors. When necessary, special appeals are made to the membership. Some programs of the society are supported by grants

from government agencies or industry organizations. Fundraising activities are handled by a full-time staff member and part-time secretary. FAS supports a paid staff of 24 and is governed by a 31-member board.

FAS seeks cooperative working relationships with industry, business, and developers on environmental issues. To avoid difficulties, including possibly damaging litigation, FAS tries to enter consultations on environmental matters at an early stage. Their programs encompass such broad ranging issues as water quality; air pollution; protection of the Everglades; oil exploration; rescue of injured birds of prey; marine turtle conservation; environmental education through films; television, workshops and public appearances; and protection of the West Indian Manatee (*Trichechus manatus*).

FAS's Save the Manatee Committee is one example of how grassroots activities can draw attention to the plight of a species. Manatees are large coastal mammals protected by both Federal and State statutes. They are frequently killed or injured by human activities such as fishing and motor boating. Working with State and Federal agencies, the committee has increased public awareness of the need to protect the manatee through a newsletter, a network of "Save the Manatee Clubs," and an "adopt a manatee" program that provides donors with information and updates on a particular animal. The result is increased public consciousness not only of the manatee itself, but also of the legal protection it receives from Federal and State law.

FAS has also been active in environmental issues within the State. They successfully opposed oil drilling in Florida's estuaries and worked for passage of the State's Water Quality Assurance Act of 1983 which protects surface and groundwater from hazardous wastes. The society continues to lobby for and inform its members of important legislation and policies affecting the Florida environment.

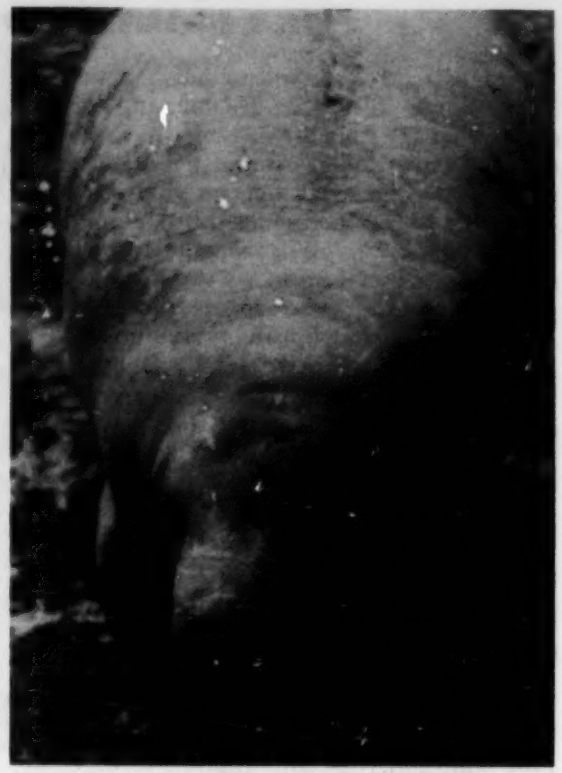


Photo credit: U.S. Fish and Wildlife Service, Denver Wildlife Research Center, and Blue Spring State Park

West Indian Manatees (*Trichecus Manatus*) regularly winter at the Blue Spring State Park near Orange City, Florida. This animal, a large male, is part of the "Adopt a Manatee" program sponsored by the Florida Audubon Society to raise support and awareness for the conservation of these animals

FAS is an example of a State organization that aids its chapters in addressing local issues and also unifies those chapters to address broad regional issues. They have a record of effective and informative interaction with Federal and State agencies, as well as with private industry. Their programs have helped maintain biological diversity by encouraging preservation of important environments as well as protection of specific species.

WILD PLANTS AND ANIMALS—OFF-SITE

For most wild plants and animals, on-site preservation maintains a far greater range of species than is possible through off-site preservation. However, where interest is focused on particular animals or plants or when a species is nearing extinction in its natural habitat, off-site methods of captive propagation may be necessary and expedient. Many groups and individuals maintain various species of wild plants and animals, though not always for the purpose of conserving biological diversity. This section highlights the efforts of groups who, for a variety of reasons, maintain wild species of plants and animals away from their native environments.

Off-site Preservation of Wild Plants

An estimated 3,000 of the approximately 20,000 plant species which comprise the flora of the United States are threatened or endangered, and equal numbers are in serious decline (68). Most of these plants are wild and threats to them include agricultural and urban expansion, pollution, road construction, forest clearing, recreational activities, and wild plant collecting.

Conservation efforts to date have focused on preserving the natural habitats of entire plant communities. While there is broad consensus that this on-site approach should remain the primary method for protecting this biological diversity, these conservation efforts are now being supplemented through living collections of wild plants (11).

A heightened public awareness of the need to conserve plant diversity has emerged only within the last 15 years. This concern at the Federal level led to the Endangered Species Act of 1973. Individual States also have implemented programs to conserve native species. In addition, a number of private institutions, societies, and individuals are working actively to preserve threatened plant species, in some cases by preserving and promoting living collection of wild plants indigenous to the United States.

These grassroots activities include individual efforts to maintain private collections of individual species, plant societies with amateurs and professional members, and institutional activities, such as botanical gardens and arboreta, that maintain extensive living collections of wild plants. The contributions and motivations of these various groups vary considerably.

The conservation impact of grassroots activities is somewhat clouded by individuals who think of collecting wild plants as a hobby much like stamp collecting. Their overcollecting, in some cases, is actually a significant threat to rare wild plants. This threat, however, is increasingly counterbalanced by national and international legislation with penalties for overcollection of species from the wild. In addition, specialist plant societies have begun to emphasize conservation as an objective, thereby becoming important contributors to efforts to maintain biological diversity (36).

The following highlights three examples of groups maintaining living collections of wild plants in the United States. The Rhododendron Species Foundation exemplifies groups which seek to preserve a single taxonomic group of plants. The Desert Botanical Garden illustrates the contributions that locally supported botanical gardens and arboreta can make in conserving both exotic and regionally threatened plants. Finally, the Center for Plant Conservation typifies the contributions a network of regional botanical institutions can make to preserving indigenous, threatened, and endangered plants.

The Rhododendron Species Foundation

Many horticultural societies and organizations exist to disseminate, collect, and exchange information on a particular group of plants. Some people associated with these groups have, in the past, contributed to loss of rare species in the wild by overcollection. Recently, however, groups like the American Orchid Society have become concerned about protecting plant species in the wild; some even encourage re-

Photo credit: Rhododendron Species Foundation

Propagation greenhouse facilities of the Rhododendron Species Foundation display some of the approximately 10,000 plants which are produced and distributed annually

search on reintroducing plants into their former habitats (36). The collections of these groups, or individual members, in many instances, contain a greater diversity within the taxonomic group than is available anywhere else.

Early in the 1960s, several members of the American Rhododendron Society formed a group to collect Rhododendron species from the old, established gardens of Great Britain. They soon realized that they needed a permanent garden site to ensure the survival of these plants. The Rhododendron Species Foundation was incorporated in 1964 in Oregon, and a garden was established in Eugene on the estate of one of the group's founders. Seven years later the collection moved to Salem, Oregon, to the property of a retired director of the Strybing Arboretum of San Francisco. Finally, the Weyerhaeuser Co. prepared a permanent home for the garden on a 24-acre site on its corporate headquarters property near Puget Sound in Washington State. The property is leased at no cost to the foundation, and ownership of all improvements on the property was transferred to the foundation in 1979. The foundation provides for all further development, maintenance, and operation.

The taxonomic genus *Rhododendron* includes nearly 1,000 species which are found all over the world. The largest diversity of species is in eastern Asia, from south China to the Himalayas and Japan (82). Species native to North America are second in abundance. The familiar ornamental rhododendrons or azaleas available throughout the United States represent only a small variety of the genus which ranges from forest trees to alpine creepers. Some species of rhododendron are nearing extinction because

of deforestation in many parts of Asia, and development endangers wild species in Florida and British Colombia (50).

The foundation's purpose is to create a center for acquisition, study, cultivation, display, and distribution of rhododendron species. They already have what is probably the largest collection of rhododendron species in the world with at least 600 documented species and more than 2,000 clones. The species have come from existing British, American, and European collections, as well as expeditions to collect wild material in East Asia, the Himalayas, Europe, and America. Although the collection provides a broad species diversity for this genus, it does not encompass the genetic diversity within those species which would be available in on-site reserves.

A recently completed Master Plan for Development provided a 22-acre display garden arranged according to botanical subdivisions of the genus. During the spring and fall, visitors pay a nominal fee to tour the garden. The foundation produces printed materials about rhododendrons and shares a large array of plant material with its members, botanic gardens, National Plant Germplasm System (NPGS), and other interested parties. The foundation continues to collect species, with particular emphasis on variants with cold hardiness or heat tolerance. The foundation also sponsored the Third International Rhododendron Species Symposium which brought together professionals and amateurs from around the world to discuss a variety of topics related to the biology and horticulture of rhododendrons.

Approximately half of the foundation's operating budget comes from sales of plants and publications and the garden Visitors Program. The rest is from membership dues and, to a lesser degree, grants and contributions from individuals and private foundations. Even though they maintain a paid staff of six to eight, the foundation depends on volunteers to assist in tending the garden, distributing plants, maintaining the library, and doing general office work. The volunteers are organized into committees with responsibilities that reflect the expertise of the members. The reference library, for example, was organized by a committee of retired professional librarians and educators; the finance committee includes knowledgeable people with backgrounds in business and finance.

To improve their financial stability, the foundation hopes to establish an endowment to pay for the daily operation of their programs. They have solicited grants, private contributions, and bequests. They have continued to improve the garden and hope to expand their income from visitor programs by completing a visitor's center.

The Rhododendron Species Foundation illustrates how a grassroots group can use limited resources effectively to develop an important and widely respected plant collection. Their association with the Weyerhaeuser Co. is an excellent example of how private industry can help a grassroots effort to become established by providing significant assistance at an early stage.

Desert Botanical Garden

The 270 public gardens and arboreta in the United States vary greatly in size, professionalism, and perceived function (4,14). However, these gardens exist in general for public display, education, research, and conservation. Their priorities are usually plants with ornamental or scientific interest rather than economic value (61).

Botanical gardens are logical repositories for living collections of endangered plants because they are integrated into the scientific community and have in-house expertise in plant propagation, specimen maintenance, and taxonomy. Despite this, only 4 percent of the threatened or endangered plant species in the United States are cultivated in public gardens (7). Historically, gardens have placed low priority on conservation, in part because visitors are attracted by showy ornamentals. Most endangered plant species lack such esthetic appeal (61).

Several developments in recent years, however, have encouraged botanical gardens to cultivate the conservationist role. The American Association of Botanical Gardens and Arboreta,

for example, established a Plant Conservation/ Endangered Species Committee in 1984. The newly formed Center for Plant Conservation also has encouraged individual gardens to assume greater responsibility for cultivating endangered and threatened indigenous wild plant species. While only a handful of gardens have risen to this challenge, the number appears to be growing.

One such garden is the Desert Botanical Garden, a nonprofit institution located on 150 acres of Arizona desert surrounded by the Phoenix metropolitan area. The garden site was part of Papago Saguaro National Monument, founded in 1914 to preserve the biological richness and unusual rock formations of this area. The land reverted to State control when the monument was abolished by Congress in 1930. Under that authority the Arizona Cactus and Native Flora Society, a hobbyist group, was granted a petition to build the botanical gardens. Their aim was to develop "a natural garden of desert plants from the deserts of the world, so arranged that it will be pleasant for the layman to view and yet can be studied by scientist."

The garden boasts a naturalistic display of about half the world's cacti and other succulents as well as trees and shrubs from arid regions of Asia, Africa, Australia, and the Americas. It maintains 33 species of crops or their wild relatives native to the North American center of diversity. Fifty-six species are listed in its *Index Seminum*, which catalogs seeds available to other botanical institutions, research stations, and universities (12). The garden also harbors plants that have endangered species status.

The Desert Botanical Garden is a science and research-oriented operation, using the best technology available to botanists. Its staff has grown over the last decade from a few self-trained amateurs to several biologists and horticulturalists with advanced degrees. Records for the collection are computerized. Seeds are carefully replenished by methods that prevent inadvertent outcrossing, and are maintained in good quality, medium-length storage facilities. Living collections of vegetatively propagated materials receive considerable weekly care. Garden staff members still have difficulty propagating rarer plants and often must use trial and error to discover suitable techniques to germinate seeds and establish cutting.

The garden supports itself by membership (currently 2,271), contributions, and admissions (12). The benefits of membership include a magazine; discounts on classes, lectures, workshops, and field trips; and bonus packets of desert plant seeds. The garden also maintains ties with other similar institutions through several professional associations. It is the lead desert-region institution for the new consortium, the Center for Plant Conservation, and propagates U.S. endangered species in association with the U.S. Department of Agriculture (USDA) and Office of Endangered Species (OES). Although genetic conservation is only a part of the Desert Botanical Garden's mandate, it makes a substantial contribution for its size.

Center for Plant Conservation

The center was formed in 1984 to create a network of regional botanical institutions with the goal of preserving living collections of all threatened and endangered U.S. plant species. These collections are intended to supplement rather than replace efforts to maintain species in their natural habitats. The center's role is:

> . . . to coordinate a permanent, comprehensive, systematic, and accessible living collection of rare and endangered plants native to the United States [and] through use of this collection, . . . [to] promote botanical research, public education, and distribution of plant material (61).

The two organizations spearheading this initiative are the Arnold Arboretum, which serves as the headquarters for the center, and the New England Wild Flower Society. The arboretum is a major botanical research center maintaining over 7,000 varieties of plants on 265 acres, funded solely through its own endowment, membership dues, and contributions. The New England Wild Flower Society is a private nonprofit organization which maintains the largest landscaped collection of wildflowers and na-

tive plants in the Northeastern United States. The society maintains the 45-acre Garden in the Woods in Framingham, Massachusetts. Six additional sanctuaries in New England total 438 acres (11).

Thus far, 18 major gardens and arboreta operating in 14 designated regions across the United States have committed themselves as participating institutions (61) (figure 2).

The center's Program Development Plan outlines four components:

1. A national network of botanical gardens, arboreta and other scientific institutions which will collaborate in endangered species preservation. These institutions will serve as scientific advisors to provide the center with the most up-to-date information about species endangerment and research efforts. Selected institutions will also serve as regional programs to house the live plant collections for their respective areas of the country.
2. A computer-based Information Management System and Endangered Species Data Bank having two parts:
   - a national inventory of species in need of ex situ protection; and
   - a listing of accessions held by the cooperating regional programs, together with horticultural information gathered from them.

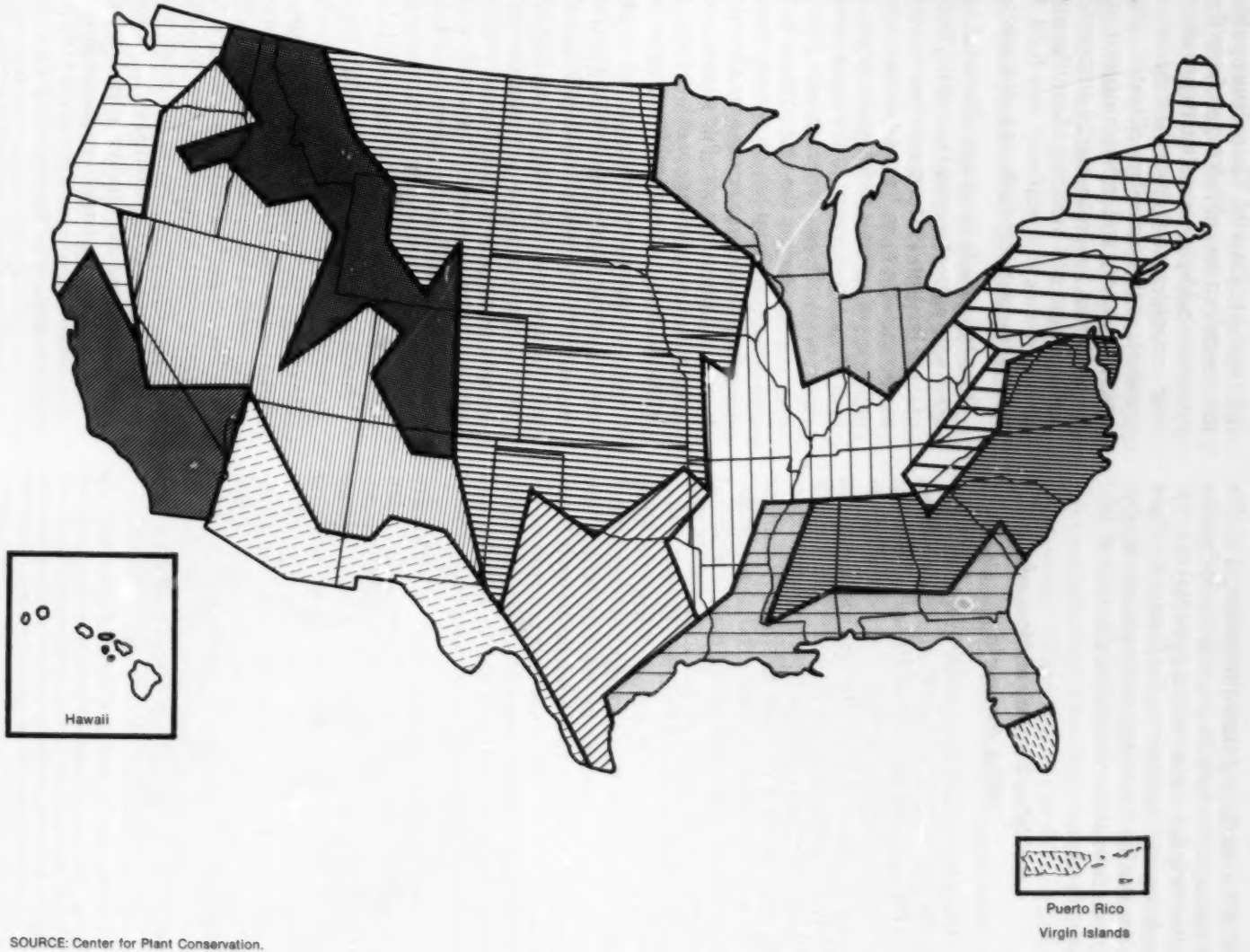
   The data bank thus will allow coordination among the member institutions, and guide the center in selecting priorities for accession and research.
3. A comprehensive live collection of planted specimens, seeds, and cutting, maintained by the cooperating regional programs. The collection emphasizes species of national significance, especially those with particular research, horticultural, or educational potential. Propagation capabilities will be an integral part of the live plant collections. This will enable the center to provide living material to other gardens and arboreta; to botanical, medicinal, and horticultural research; and to conservationists engaged in species reintroduction and habitat reconstruction.
4. Support of research and education activities furthering public awareness and scientific understanding of the issues of species extinction.

The center cites several reasons for its program. First, botanical institutions are integrated with the scientific community. Second, their staff members already have expertise in such areas as plant propagation, transplants, and tissue culture. Third, they have unique opportunities to raise public awareness of species extinction. The center also has identified specific functions that could be fulfilled by a botanic garden/arboretum-based conservation program (11). It seems, however, many of these functions could be carried out only by larger botanical institutions (61):

- emergency sanctuary for populations or whole species facing imminent extirpation in the wild;
- a cooperation in a "species alert" network among botanical and conservation institutions;
- critical species research facilities to study a target population which begins to decline, even on protected land;
- propagation of rare plants for applied research and horticulture, thus decreasing collection pressure on wild populations;
- development of new cultivation techniques for the handling and growth of rare plants;
- propagation of plants for reintroduction into the wild, in reconstructed or protected habitats;
- research on species biology, in many cases the first opportunity to perform even basic study on these species; and
- public awareness of species extinction, including unique living exhibits of regionally rare flora.

The 1985 annual budget for the center is about $150,000 to $200,000. The 1986 budget is expected to be about double this, largely reflecting an increase in plant collection and management activities. Financial support for the center comes from grants and gifts from foundations, corporations, and individuals with two foundation grants comprising about three-quarters of the total budget (69).

Figure 2.—Regional Responsibilities for Gardens and Arboreta Participating in the Center for Plant Conservation Program (specific regions are adopted by participating organizations to ensure attention to all States excluding Alaska)



SOURCE: Center for Plant Conservation.

It is too early to assess the potential of this program in meeting its goals. Nonetheless, by cultivating the conservation potential of existing botanical institutions, the Center for Plant Conservation is making an important contribution in maintaining biological diversity of wild plant species.

Off-site Preservation of Wild Animals

Grassroots activities to preserve wild animals[4] are diverse both in terms of the people involved and the nature of their efforts. They range from individuals raising or breeding wild birds at home to consortiums collecting animals from the wild, protecting and reproducing them in a network of zoological gardens, and reintroducing them to their original habitats. A number of groups are concerned with the large populations of formerly domestic animals now found wild (feral) primarily on public lands (28). Examples include the wild burros (*Equus asinus*) of the West which are remnants from the early gold rush era and the wild pigs (*Sus scrofa*) and goats (*Capra hircus*) of Hawaii which are descendants from animals left by the early European explorers. These animals are viewed variously as potential reservoirs of disease, detriments to preservation of native species, and sources of valuable genetic resources (28).

Concern about maintenance of diversity among wild animals is unequally distributed among taxonomic groups (36). By far the greatest efforts have been made on behalf of "mammals ranging from the large and awe-inspiring to the small and cuddly" (36). One survey revealed that 17 of the 19 known orders of mammals are represented by species in captivity (60). Captive breeding of birds has tended to concentrate on relatively few species, notably parrots and birds of prey, chosen for factors other than their status in the wild. The existing public and private collections of fish, apart from those of interest to hobbyists, are almost entirely assembled and replenished from the wild (36). While breeding of the American alligator (*Alligator mississippiensis*) and Indian mugger (*Crocodylus palustris*) has been highly successful, the management and breeding of reptiles and amphibia in zoos is a relatively new field. Invertebrates have scarcely been considered.

Zoos have made the major efforts to breed diverse wild animal species in captivity (36). Most of these institutions have evolved beyond their earlier mission to gather and display a diverse collection of animals and devote a great proportion of their resources to the maintenance of rare species of birds and mammals. Zoos, however, are limited by the size of their facilities, and decisions about which species should receive their limited resources are a chronic problem. In addition, responsible genetic management requires maintenance of large populations which may be impractical for a single facility.

The American Association of Zoological Parks and Aquariums (AAZPA) is a professional organization representing approximately 175 facilities in the United States and Canada (23). Its primary objective is to conserve species by coordinating the efforts of the zoo community to gain the greatest benefit from the available space. The AAZPA Species Survival Plans (SSP) currently oversee proper genetic management of some 30 captive animal species (1).

Some efforts to preserve wild animals focus on maintenance of viable populations on-site. This requires captive breeding of a species, in some instances, so it can be reintroduced to its native habitat. Zoos have participated, through AAZPA, in such efforts, but rarely for native animal species. By contrast, the FWS Patuxent Wildlife Research Center has bred and reintroduced over 60 threatened species of reptiles, birds, and mammals native to the United States (21,36). They also have been successful in breeding desert fishes in captivity at the FWS National Fish Hatchery in Dexter, New Mexico.

The efforts discussed in this section illustrate two very different ways in which grassroots

[4]Some disagreement exists over use of the terms "wild" and "exotic." For many, wild species are those found in natural environments and exotics refer to feral populations of domestic animals. In other cases, exotics are simply wild animals not native to this continent (e.g., African antelope species). In this background paper, wild animal species are those presently or previously found to exist in the wild in essentially the same form as in their captive state.

groups contribute to the maintenance of biological diversity. The American Federation of Aviculture (AFA) supports a large number of private individuals who keep and breed exotic birds and is an example of wild animal hobbyists groups. On the other hand, Texas game ranchers collect and breed animals on a scale even greater than most zoos.

American Federation of Aviculture

Many private citizens maintain collections of birds, reptiles, and mammals. For some of these hobbyists maintaining diversity is a consequence, not a goal, of their efforts. Animals, for example, are usually raised for reproduction, with the hope of profiting from sales of their offspring. On the other hand, many privately owned reptile and bird collections are extensive and professionally managed to conserve species. It is claimed that their efforts to reproduce species which are difficult to breed under controlled conditions, when successful, may discourage the illicit trade in endangered and threatened species by lowering prices enough to make collection in the wild unprofitable—a point of considerable disagreement.

National and regional societies support individuals interested in captive breeding of wild animals. The sophistication and scope of such groups varies with the interests and goals of the individuals involved. Some simply exchange cultural information; others are making efforts to establish detailed records of the breeding histories for captive species to assure genetic diversity of the animals.

The World Pheasant Association of the United States (WPA/USA) is an example of a small conservation-oriented association with the twin goals of habitat and species preservation (58). Field studies are supplemented by captive breeding programs with qualified breeders. The organization, with its small membership, has had to rely on intensive public and private fund raising endeavors to accomplish its goals.

AFA is a large, well-organized, national organization that serves private breeders of exotic bird species. AFA holds an annual convention and is politically active in support of its members' interest. A bimonthly magazine, *The AFA Watchbird,* informs members of important national and regional matters related to keeping wild, nonnative, bird species. The group also funds conservation projects, and research on avian diseases and the conditions necessary for the maintenance of healthy animals. They have encouraged cooperation of members on projects involving captive breeding of birds.

One example is their recent cooperation with AAZPA to develop a breeding consortium for the rare Black Palm Cockatoo (*Probosciger aterrimus)* (58). Approximately 100 of these birds, brought into this country illegally in the fall of 1983, were intercepted by U.S. Department of the Interior officials. Through a concerted effort by AFA and AAZPA, DOI allowed these birds to be distributed among consortium members. AFA members are maintaining a breeding registry and will participate in a master plan overseen by AAZPA designees at the Baton Rouge Zoo in Louisiana. Such cooperation has been possible, in part, because private citizens have both the capabilities and facilities to accept these birds.

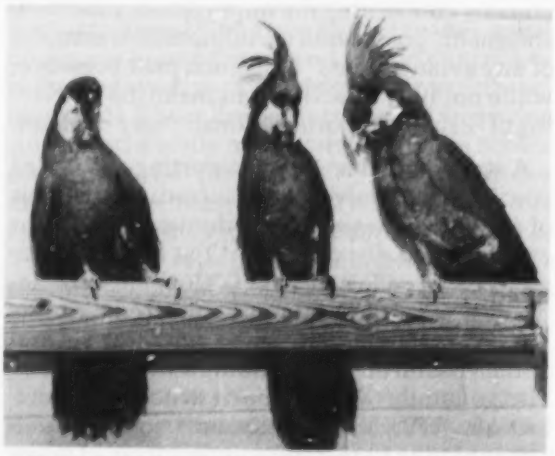


Photo credit: U.S. Fish and Wildlife Service, Division of Law Enforcement

Black Palm Cockatoos (*Probosciger aterrimus*) at the National Zoo, Washington, DC, February 1984. Amateur bird breeders, in cooperation with the American Federation of Aviculture, the American Association of Zoological Parks and Aquariums, and Federal agencies have formed a consortium for the captive breeding of this rare bird

AFA conducts a regular survey to determine the type, population, and reproduction success of bird species being maintained in captivity. While not exhaustive, this survey provides better information on the private breeding and maintenance of birds than is otherwise available. Such information is essential to locate individuals for breeding programs like that designed for the Black Palm cockatoo. They also monitor the success of individual captive breeding efforts and award successful efforts as well as those member activities which encourage other bird keepers to gain and pass on skills in captive breeding.

Some people are concerned that private collectors contribute to the trade in endangered species, particularly native birds of prey. Numerous statutes limit the possession of such birds (25), and at least one State forbids the sale of any wild collected bird in order to limit trade in endangered and illegally imported animals. Private collectors argue that such laws restrict legitimate efforts to propagate rare species and actually encourage illicit trade (34,37). Societies such as AFA discourage illegal activities by refusing membership to persons who have ". . . been convicted of violation of any State or Federal law concerning the importation, interstate shipment, possession or inhumane treatment of any avian species" (76). Such peer pressure, while not fully effective, can make the marketing of illegally imported animals more difficult.

A second problem is that importing exotic bird species may inadvertently introduce diseases of serious consequence for domestic fowl. For example, the discovery that the highly contagious Newcastle's disease (Velogenic Viscerotropic Newcastle Disease) can infect exotic birds has been of great concern to aviculturists and animal health officals. Finding a single infected bird generally requires the destruction of a collection. AFA has established telephone networks among its members to alert them of emergencies such as disease outbreaks. They also are working to gain improvements in postquarantine holding and transfer facilities that would prevent healthy imported stock from being mixed with infected birds already in this country.

Individuals keep wild animals for diverse reasons, ranging from personal taste to a desire to conserve rare and endangered species. Most of these people keep animals as a hobby and probably contribute little to the overall preservation of biological diversity. However, the success of a few private breeders with some exotic, endangered species may, it is argued, reduce the prices for those species and make collection from the wild unattractive. By monitoring the activities of individual breeders, groups like AFA can be important links to a large, diverse sector from which accurate, well-maintained records of activities are otherwise unavailable (58). Such records can provide breeders with valuable technical information and access to larger, more genetically diverse populations.

Texas Game Ranches

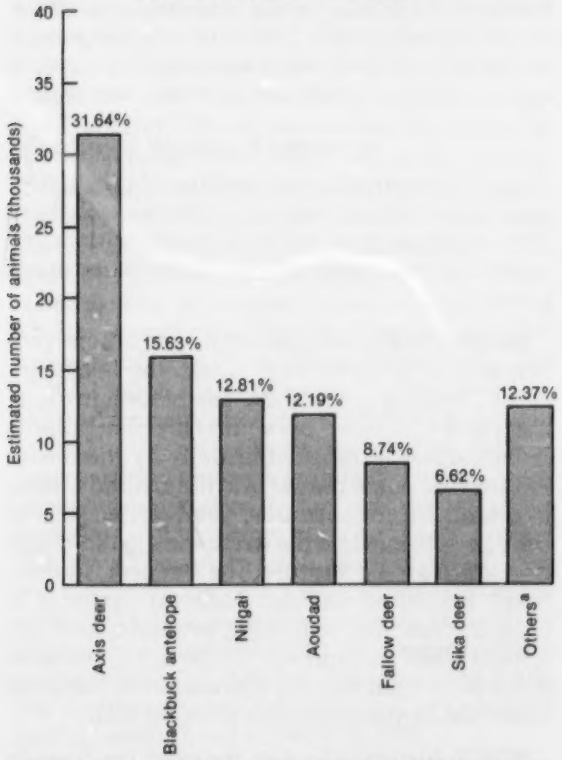
Individual interest sparks some grassroots conservation projects, including the present efforts to breed exotic animals on ranches in Texas, Colorado, Missouri, New Mexico, Florida, and Hawaii (77,83). The work, which began more than 50 years ago in Texas, has been both highly praised and sharply criticized. Although these efforts are similar to those of other individual collectors previously discussed, the scale of these operations as well as the high costs associated with acquisition and maintenance of exotic mammalian stock restricts this pursuit to a few individuals whose inclination is backed by adequate resources.

The first Texas game ranch dates back to the 1930s when the King Ranch purchased several Nilgai (*Boselaphus tragocamelus*), a prolific species of Asian antelope (83). In their south Texas home, the antelope readily grew into a sizable, though reportedly ill-tempered, herd. Another Texas ranch in the 1940s established herds of blackbuck antelope and exotic deer species. Intrigued by this latter success, other Texas ranchers soon boasted varied collections of African and Asian species. Ranchers, by 1960, were allowing interested parties to hunt exotics (some nearing extinction in their native lands) for trophies. They began, over the next several years, to form associations with zoos to gain ac-

cess to animals which were otherwise restricted by USDA quarantine. In many cases, ranchers purchase parent stock, donate them to zoos, and purchase the offspring.

The present scope of exotic wildlife ranching in Texas is impressive (figure 3). The Texas population of the blackbuck antelope (*Antilope cervicapra*), for example, exceeds that in its native Asia (58). Texas has at least 600 ranches, and "private reserves" are forming in other regions (77). The success of many ranches has made the United States a net exporter of some species of exotic deer, antelope, and other hoofed animals (77). Trophy hunting still occurs, and a market has developed for the meat from surplus animals. Many ranchers also are becoming more conservation oriented and animals from some ranches have been reintroduced into former native habitats. The potential to "recreate" lost populations of animals in their original lands is often cited as justification for working with exotic animals nearing extinction.

Figure 3.—Major Exotic Wildlife Species Held by Private Ranchers in Texas



[a]"Others" consists of at least 49 species with populations statewide ranging from 1 to 5,636. For 32 of these the total animals in Texas is less than 50.

SOURCE: Texas Parks and Wildlife Department, 1985.

Because space limits the captive breeding programs in zoos, participants in AAZPA's SSP (see p. 30) have turned to Texas ranchers for help in breeding large vertebrates such as Grevy's zebra (*Equus grevyi*), Scimitar-horned oryx (*Oryx tao*), and black (*Diceros bicornis*) and white (*Ceratotherium simum*) rhinos. The ranchers provide land, fencing, shelter, and maintenance for the designated animals; AAZPA contributes selected animals and a comprehensive management plan. Some ranches have been reluctant to join because AAZPA restricts hunting of the offspring in such programs. Nonetheless, the program has grown to include ranches outside Texas. A New Mexico ranch, for example, is cooperating with SSP on a plan to propagate Grevy's zebra (*Equus grevyi*), Przewalski's horse (*E. przewalski*), and the Tukmenian kulan (*E. hemonius kulan*).

Some of the efforts of Texas ranches have been controversial. When five black rhinos were imported for breeding on two Texas ranches, some observers hoped the project would contribute to the preservation of a rapidly disappearing species (6,83). Those hopes were dashed when one rhino died shortly after arrival and two others died within the first year (77). In addition, the animals were found to be carrying an exotic tick species which could be a hazard to livestock. The incident raised questions not only about the importation of wild animals by ranchers but also about the quarantine practices which admitted the infested animals (83).

Another concern is whether individual ranchers have the expertise to breed exotic animals. Conventional wisdom says that people who successfully manage large domestic herds can be equally successful with exotics. Though this certainly has been true of many species, such as the axis deer (*Axis axis*), blackbuck (*Antilope cervicapra*), and sika (*Cervus nippon;* figure 3) (83), it may not hold for species such as the rhino. Without long-term genetic manage-

ment some experts fear these animals may become so adapted to their ranch environments that they will no longer survive if reintroduced into their native habitats. The growing numbers for some species in Texas, however, presently exceed those found in their declining natural populations. Numbers can, in some cases, be somewhat misleading as the animals may all be descended from a very few initially imported individuals. The large number of Nilgai, for example, can all be traced back to the original imports by the King Ranch.

Finally, ranchers are frequently reluctant to institutionalize or to allow their projects to be managed by outside experts. These collections, as big as they are, still belong to private individuals. As such, they may not survive unless they provide sufficient income to at least cover the costs. Many ranchers have made efforts to provide long-term stability by establishing foundations, donating stock to universities or zoos in Texas, or other mechanisms which would continue the work beyond their lifetimes (70).

Limited resources of zoos make it difficult to save many large vertebrates. Individual ranchers, by providing much needed space and resources, can make a valuable contribution. Many organizational and long-term management problems still exist, but ranches have the potential to preserve numerous large animal species in large, genetically diverse populations.

AGRICULTURAL CROPS AND LIVESTOCK

Conservation of a broad range of genes in seeds, gametes, and living organisms is necessary for the development of new crop and livestock breeds as well as other advances in agriculture including scientific study to understand the life processes of agricultural crops and livestock. The historical or cultural significance of some breeds or crops (e.g., the place of Texas Longhorn cattle in U.S. history) also provides a motivation for their conservation.

The groups highlighted in this section represent examples of a wide range of activities and motivations. They are united by their concern for plants and animals of agricultural significance. Their methods reflect constraints of finances, expertise, and facilities with which they operate.

Preservation of Agricultural Plants

> The greatest service which can be rendered to any country is to add a useful plant to its culture.
>
> —*Thomas Jefferson*

If Americans had to subsist on those food crops native to the United States, staples such as cereals and potatoes and most standard fruits and vegetables would be absent from their diets. Even corn and most of the bean and squash varieties, on which much of the native American Indians depended, were developed from species introduced much earlier from what is now Mexico, and Central and South America. Early immigrants to the United States quickly learned that, if they wanted their traditional crops, they would have to bring seeds and plants with them (72). As wave upon wave of immigrants came to this country, the diversity of introduced crops grew.

Introducing new crops became an official government activity in 1819, when the Secretary of the Treasury enlisted the help of foreign diplomats and U.S. Navy personnel to collect plants from abroad. Prompted initially by the desire to introduce new plants into the United States, and later by concern over inadvertent loss of crop germplasm and the narrowing genetic base of American agriculture, the Federal Government instituted various national systems to collect, describe, maintain, evaluate, and distribute plant germplasm. These activities have evolved to what is today known as the National Plant Germplasm System (NPGS) (81).

NPGS historically has focused on foreign germplasm, collecting landraces and wild relatives of commercial crops from their centers of

diversity located primarily in developing countries. Relatively little action has been taken to ensure that traditional American varieties are preserved—particularly heirloom vegetables and fruits. In addition, some concern now exists over how little Federal attention has been paid to the preservation of many commercial, open pollinated varieties of garden seeds being dropped by major seed companies in the United States—an accelerating trend that has been associated with consolidation in the U.S. seed industry (32,79).

Grassroots individuals and organizations today are preserving a significant amount of crop genetic diversity not found in government or institutional collections (24,33,41). The rapid increase in membership in these organizatons over the past decade is evidence of the growing interest in, and concern for, threatened traditional varieties. This section of the background paper highlights a number of grassroots groups addressing the two gaps in the Federal germplasm system described above—lack of attention to traditional varieties and to varieties no longer available from commercial sources.

The Seed Savers Exchange

The Seed Savers Exchange (SSE) is a networking and seed banking organization which stands out not only in the scope and importance of its work but also in the role it plays in the grassroots genetic conservation movement (24,41). The organization's founder, Kent Whealy, became involved with heirloom seeds in the fall of 1973 when his wife's grandfather gave him seeds of three garden plants his family brought to the United States from Bavaria four generations earlier. Sparked by a determination to preserve those varieties and a curiosity about the prevalence of heirloom plants, Whealy formed SSE which began, in 1975, as a loosely knit network with six members who exchanged seeds and information on heirloom plants. It has since evolved into a not-for-profit, tax exempt organization whose 450 member/gardeners are working together to save heirloom and endangered garden seeds from extinction (80).

The backbone of the organization is its yearbook. The *1985 Winter Yearbook* lists names and addresses of all members with the seeds they have available for exchange and those they are trying to locate. The 256-page yearbook includes 3,500 varieties, most unavailable from commercial sources. During the last 10 years, SSE members have supplied other gardeners with enough seed samples of heirloom or unusual garden varieties to make an estimated 300,000 plantings of noncommercial vegetable varieties that were not in any seed catalog and were, in some cases, on the verge of extinction (41,80).

Although the yearbook's primary function is to facilitate seed exchanges between members, it includes other features. A plant finder service assists those who are searching for historic seedstock or for varieties that are no longer commercially available because they have been dropped from seed catalogs. Articles by experts educate members on backyard techniques for maintaining genetic integrity of rare seedstocks and maintaining viability of stored seeds. Published correspondence informs members about other organizations and individual curators who are conserving rare vegetable varieties and provides a forum for discussion of genetic conservation and related agricultural issues (41).

SSE also is concerned with endangered commercial varieties of garden vegetables. An SSE publication, *The Garden Seed Inventory,* is an effort to document the loss of garden vegetable seeds offered commercially. The 448-page inventory covers 239 seed companies in the United States and Canada and describes the 5,785 nonhybrid vegetables they still sell. While the inventory illustrates impressive diversity in the vegetables available commercially, it also reveals some disturbing facts (table 2). Of most concern is the revelation that 2,792 varieties (48.3 percent) of all nonhybrid garden varieties were available from only one of a possible 239 commercial sources, and 3,434 varieties (59.4 percent) were available from only one or two commercial sources. The number of open pollinated varieties dropped by the seed companies increased during the course of the 3-year inventory (79,80).

Using the inventory as an early warning system, SSE has identified those varieties most threatened with commercial extinction and is

Table 2.—Open Pollinated Vegetable Varieties Dropped From Seed Company Catalogs

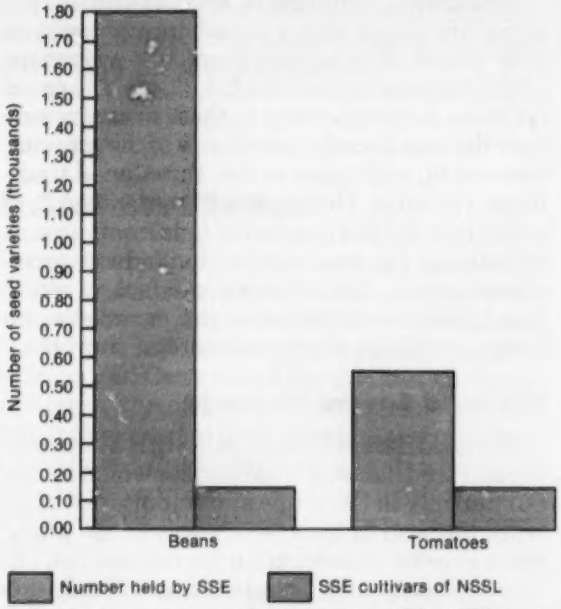
Year	Companies inventoried	Number of varieties	Dropped during that year	Percent of the total
1982	138	—	117	—
1983	184	—	237	—
1984	239	5,785	263	4.5%

SOURCES: K. Whealy (ed.), *The Garden Seed Inventory* (Decorah, IA: Seed Saver Publications, 1985). K. Whealy, "Role of the Seed Savers Exchange in Maintaining Genetic Diversity," discussion paper prepared for the Office of Technology Assessment Workshop on U.S. Grassroots Activities in Maintaining Biological Diversity, August 1985.

trying to acquire as many of these varieties as possible. They purchased 1,200 of these varieties in 1985 and intend to double this number in 1986. Whealy's own collection of heirloom material now totals 4,000 accessions; including 2,200 beans, 600 tomatoes, 400 squash, 200 potatoes, 200 corns, 100 peppers, 100 watermelons and 100 muskmelons. One recent study found that the SSE collection contains a significant number of varieties not maintained by NPGS. In each of five crops investigated (beans, tomatoes, watermelon, spinach, and beets) a large percentage of the SSE collection was not included in the National Seed Storage Laboratory (NSSL) (24) (figure 4).[5]

A Growers Network of amateur gardeners helps multiply and replenish SSE seedstock. Though many growers are reliable, the network as a whole returned seed with a "mistake" factor of 8 to 10 percent, raising serious questions about whether such a network can permanently maintain such a large collection (80). As a backup to the Growers Network, Whealy plans to grow out his entire collection, using a 3-year rotation, on a rented 5-acre field in Decorah, Iowa. In the first grow-out in 1985 Whealy, assisted by his son and one volunteer SSE member, planted some 2,000 vegetable varieties. All vine crops and corns were hand-pollinated, and peppers were caged to preserve seed purity. The grow-out also allowed Whealy to evaluate unique characteristics and record valuable data on the relative performance of the varieties.

Figure 4.—Numbers of Bean and Tomato Varieties Held by Seed Savers Exchange Contained in the U.S. National Seed Storage Laboratory



SOURCE: C. Fowler, "Grassroots Genetic Conservation Efforts," OTA commissioned paper, 1985.

SSE hopes eventually to develop its own "preservation farm" with a large trial garden as well as a system of specialized greenhouses and underground root cellars. The organization also would like to expand its conservation activities to include livestock, poultry, fruits, nuts, berries, and wild relatives of food crops. Ultimately, it hopes to develop a network of a dozen such farms in different climates around the country, maintaining and evaluating such collections (80). SSE will have to broaden its funding base significantly to accomplish all this. Currently, SSE operates on an annual budget of

[5]This study only examined which SSE varieties were held at the NSSL. While, in principle, NSSL is responsible for maintaining duplicate samples of all varieties held in other National Plant Germplasm System (NPGS) collections, this has not been the case in practice. Thus, numbers cited for the NSSL may not reflect total collections in the NPGS.

$40,000 mostly from membership and sales of publications. Grant funding, averaging about one-quarter of SSE's budget, has been received from private foundations, and for one project, from a private seed company.

In sum, SSE serves to maintain biological diversity by maintaining its own collections of heirloom and commercially endangered varieties; promoting the adoption of these rare varieties among other gardeners; and educating its members and others on issues important to the maintenance of biological diversity. As a network organization, it has been able to pool the dedication, knowledge, and resources of a core group of vegetable growing enthusiasts, enhancing their overall contributions to vegetable variety protection than would be possible if these individuals did not interact. SSE also has become a focal point for information exchange on rare varieties, a clearinghouse of information on what heirloom vegetable varieties are being maintained at the grassroots level, and where to acquire them. In this capacity, SSE could serve as an intermediary between the numerous grassroots individuals preserving crop diversity and the government activities with responsibility to do so.

North American Fruit Explorers

NAFEX, the North American Fruit Explorers, is a nonprofit organization of 3,000 hobbyists who locate, test, and preserve superior or special fruit and nut varieties regardless of their commercial importance. NAFEX deals regularly with 21 woody, nut- or fruit-bearing species native to the North American continent (46).

NAFEX began with a few dedicated fruit enthusiasts circulating round robin letters in the early 1960s. This informal network had grown so large by 1967 that it took 2½ years for the collection of letters to get through the entire group, so the group decided to publish a quarterly magazine called *The Pomona* after the Roman goddess of fruit. Today the leadership and membership of NAFEX are widely dispersed. Its president lives in Michigan, its vice-president in Indiana. *The Pomona* is edited in Illinois and printed in Wisconsin. The 1985 annual meeting was held in West Virginia (24).

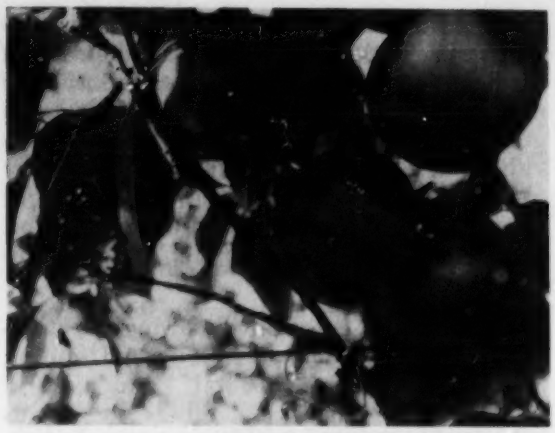


Photo credit: Elwood Fisher

The now rare "rusty coat" apple being maintained by NAFEX member Dr. Elwood Fisher. It originated in the Southeastern United States some 200 years ago, and was commonly grown by early pioneers because of its good keeping qualities

Although they call themselves "hobbyists," NAFEX includes many amateur horticulturalists with specialized skills in plant propagation. They share their technical knowledge with others through workshops on grafting, air-layering, pest control, and plant propagation and management techniques (24,40). The organization also maintains a lending library through the mail, and they occasionally give small research grants. Moreover, they sponsor groups to evaluate and research some 30 types of fruit. In many cases, the collections of NAFEX members contain rare clones or varieties not available elsewhere. Members frequently seek abandoned orchards to locate and rescue unique or threatened varieties.

One NAFEX member for whom preserving biological diversity is a major goal is Dr. Elwood Fisher, a biology professor from Virginia, who maintains what is believed to be the largest private collection of heirloom fruit in the United States. On only half an acre of land, he has created a preservation orchard containing 840 kinds of apples, 160 pears, 52 cherries, 27 plums, 15 peaches, 47 apricots, 20 grapes, 21 blueberries, and many varieties of other fruits and berries—about 2,000 different varieties in all (24).

Although NAFEX had difficulties obtaining samples from the USDA regional plant intro-

duction stations during its early years, a more reciprocal relationship has been developed with certain scientists at Federal Clonal Repositories and Plant Introduction Stations. While some grassroots groups such as NAFEX praise individuals in government for their support, they remain critical of the lack of formal government commitment to greater cooperation with and support for grassroots genetic conservation work (24).

While NAFEX is a relatively strong and growing grassroots organization, its limited funding restricts its potential. Its staff is unpaid and funds are raised through membership. No outside funding from government or foundations has ever been sought or received. Currently, the organization uses a computer only for its mailing list, but members would like to create a computerized list of fruit and nut varieties and their locations—a grassroots version of the Federal Government's *Fruit and Nut Germplasm Inventory* (24). Although such a database could help identify threatened varieties which exist only in private collections, current funding does not permit such an ambitious project.

Government breeding activities have focused largely on preserving and developing fruit varieties with qualities suited to commercial production, including appearance and transportability. In contrast, NAFEX members are less concerned with these commercial qualities, focusing more on maintaining fruits with exceptional qualities such as particular taste, texture, or qualities well suited to backyard gardeners.

NAFEX members are thus engaged in maintaining, promoting, and researching a broad range of fruit varieties that would otherwise be ignored. Their research, acquisition of foreign varieties, and breeding activities have enabled them to enhance the quality and growing range of numerous types of fruits which, in some cases, has encouraged public or commercial research activities on a particular variety. To this end, their activities in genetic conservation has served not only the interest of their membership but, more broadly, the public interest.

Regional Seed Exchanges

Many regions of the United States now have either a nonprofit seed exchange or a small seed company specializing in garden vegetables, fruits, or wildflowers which are adapted to local soil and climate. Most of these organizations are less than 10 years old. Many have arisen from grassroots concern over trends in the seed industry, particularly the tendency for larger seed companies to replace regionally adapted varieties with more profitable all-purpose varieties (41). While this trend toward consolidation is not unique to the seed industry (reports of mergers and buy-outs in various industries have become a staple in the media), its consequences are particularly unsettling in the seed industry because varieties which lose the protection of a seed company may become extinct, contributing to the loss of biological diversity.

Small regional seed companies often encounter unique problems. For some, customer demand is too great for them to grow their own seed yet too small to justify the relatively large minimum orders required by commercial seed growers. Some States assess an annual registration fee for each variety marketed. While the fees generally are inconsequential for large high-volume companies, they can be substantial for a small company selling only a few packets each of a relatively large number of varieties. The greatest problem, however, is that small companies cannot generate enough customers to be self-supporting. Regional nonprofit seed exchanges are one solution to this problem.

The Abundant Life Seed Foundation is an example of a small seed company that became a nonprofit regional exchange. Abundant Life was founded 10 years ago as a small solely owned seed business. Forest Shomer, its founder, gradually decided that his goal was to distribute seeds rather than profit from them, so he formed a nonprofit organization dedicated to teaching people about growing and collecting seeds. The 10,000 member organization, located in northwestern Washington State, deals mainly with indigenous or naturalized plants of the Pacific Northwest. Its services to the peo-

ple of that region include seminars, apprenticeships, a catalog of seeds and books for sale, and a calendar listing seed-collecting time for 350 wild plants. Proceeds from these activities provide the foundation's annual budget (in 1983) of $80,000 (64).

The Abundant Life Seed Foundation sells seeds of 500 species (44). Of those, they grew their own seed for 200 crops on 2 acres of land in 1985. They hope to expand their propagation efforts in the future to increase stocks of heritage varieties received from other collections, as well as regionally adapted varieties that have become commercially scarce (2). Another goal is to gather 2,000 plant species native to the region.

Native Seeds/Southwestern Endangered Aridland Resource Clearing House (Native Seeds/SEARCH), another regional nonprofit group, is concerned with conservation of agricultural crop varieties and their wild relatives of the American Southwest. They are particularly concerned about traditional native American crops threatened with extinction and use on-site and off-site techniques to preserve the diversity of these crops. Specifically, their goals are to preserve specific genetic types, conserve lands where wild crop relatives are found, and restore traditional agricultural systems of native Americans in the Southwestern United States and northern Mexico.

The activities of Native Seeds/SEARCH are many and varied. Staff members have accompanied national and international expeditions to remote areas of the Southwest to locate and collect seeds of wild plants which are closely related to modern crops. Seeds of these plants are collected, multiplied, and stored.

The group also works with the Arizona chapter of The Nature Conservancy to promote preservation of specific areas which contain important populations of wild crop relatives and they have sought endangered species protection for critical and rare crop relatives.

Native Seeds/SEARCH seeks out traditional crop varieties found in native American gardens. These are provided at modest charge to interested gardeners, but free to researchers, individual native American families, and nonprofit organizations.

The organization also pays native American farmers to replenish the seed to encourage them to farm rather than work elsewhere for wages. To encourage the local use of these plants, nutritional and other information is provided through cultural education programs.

Support for the activities of Native Seeds/SEARCH comes from membership dues and the sale of seeds and publications. The bulk of their operating expenses is provided by grants from private foundations with some additional project-specific support coming from a private corporation. This foundation support is critical to the continuation of the broad range of Native Seeds/SEARCH activities.

Regional seed exchanges like Abundant Life Seed Foundation and Native Seeds/SEARCH provide very specific, local assistance to farmers and gardeners. They commonly preserve and distribute varieties that have been overlooked or abandoned by large companies. Further, they play an important role in the preservation of little-known native crop varieties. Such exchanges also allow interested individuals to distribute a broad range of seed varieties without the restrictions associated with operation of small seed companies.

Living Historical Farms

Living Historical Farms are open-air museums that re-create and interpret the agricultural activities of a particular time and place in history (84). Some 200 such museums are believed to exist in North America, and at least 10 million people visit them each year (48).

Historically, these institutions meticulously have re-created the architecture, hardware, costumes, and other objects associated with farming in the place and period they portray. The crops and livestock displayed frequently have been anachronisms. Many museums purchase modern varieties of vegetables to plant in their gardens or plow using animal breeds not appropriate for the time period (28,33,84).

A number of these institutions more recently have committed themselves to researching and displaying historical varieties of crops and appropriate breeds of livestock. Much of the impetus for this activity comes from the Association of American Living Historical Farms and Agricultural Museums (ALHFAM) which formed a Seeds and Breeds Committee in 1981. The committee split into separate committees specializing in seeds and animal breeds in 1984. During workshops at the 1985 ALHFAM convention both committees reported on efforts at some museums to incorporate historically accurate crops and breeds in their interpretive programs. The workshops became a forum encouraging better communication among member organizations, appropriate government agencies, private companies, and other grassroots programs (84).

The conference also outlined how living historical museums could contribute to the preservation of plant and animal genetic diversity both by actually maintaining historical breeds and seeds and by educating visitors about the importance of biological diversity to agriculture. Public education seems to have the greatest potential in part because living historical museums can expose such a large segment of the public to the genetic preservation issue (84). A good example is the National Colonial Farm (NCF), an 18th century tobacco plantation run by the Accokeek Foundation in Accokeek, Maryland. After 20 years of collection, preservation, and research on old plant varieties, NCF is at the forefront in agricultural interpretation for living historical farms. The foundation's research programs on agricultural history, restoration of the American chestnut tree, heirloom plant varieties, land preservation techniques, and native flora provide background for their interpretive programs (41). The success of the program stems from an institutional commitment to preserving old varieties as reflected by the presence of a full-time horticulturist on the staff.

NCF intends to increase its educational activities by developing a permanent exhibit which will explain genetic diversity. They also are working with local schools to tailor interpretative programs which teach students, as well as older visitors, the importance of biological diversity to modern agriculture. The goal is to make visitors aware that, although some older varieties look less productive or appealing, the genetic material they contain has enabled plant breeders to develop the more productive and disease-resistant varieties available today (49).

Photo credit: National Colonial Farm

Interpreter describing herb garden to visitors at the National Colonial Farm, Accokeek, Maryland

The Genesee County Museum, a re-created 19th century village in Mumford, New York, educates its visitors about the value of heirloom vegetables. They spread the word about genetic diversity through an annual harvest festival which features displays of old varieties of fruits and vegetables as well as old livestock breeds that are rare today. Seeds from their heirloom vegetable garden are on sale every spring. These programs make gardeners aware that these old varieties, like the other historical artifacts that the museum displays, are heirlooms that should be preserved (33).

The Oliver H. Kelley Farm in Elk River, Minnesota, is another living historical farm that actively educates visitors on the historical importance of old crop varieties. Although surveys indicate that visitors to living historical farms are more interested in crafts demonstrations than crops, Tom Woods, the director at the farm, feels that educating the public about old crops is one of the most valuable roles a museum can

play. Accordingly, Wood weaves the history of the old varieties being grown on the farm into the farm's interpretative program (33,84).

Each of these institutions is committed to researching and maintaining historically accurate varieties, an effort that can consume considerable staff time and funding. Tracking down or re-creating old varieties by back-crossing can be particularly time-consuming. Dedicated individuals in these institutions have solicited assistance and seed stock from outside sources, including universties, USDA Plant Introduction Stations, private seed companies, and grassroots seed exchanges. By sharing information and seeds, these pioneer programs have made it easier for other living history farms to begin similar programs.

Maintaining livestock also is an important factor in re-creating farm environments of the past (20). Yet because they lack space, financial resources, and skilled personnel, 80 percent of ALHFAM's 600 members have no livestock programs of any kind (20). Old Sturbridge Village (Massachusetts), Colonial Williamsburg (Virginia), Plimoth [sic] Plantation (Massachusetts), and Sleepy Hollow Restoration (New York) are among the exceptions.

Because they want breeds that look historically accurate, museums have put an emphasis on re-creating physical appearance (phenotype) rather than genetic accuracy (genotype) of the original breed (28). Today, an emerging interest in rare breed conservation has sparked increased concern for preserving genotypes (28).

Avoiding detrimental inbreeding in livestock requires populations larger than can be kept at most living historical farms. Old Sturbridge Village has maintained Milking Devon cattle and Tamworth pigs by cooperating with local breeders who maintain large breeding herds and who supply animals to the museum (63). Old Sturbridge Village is also one of very few living historical farms to fund the collection and storage of semen from bulls of rare breeds (28).

The exemplary programs highlighted in this section are exceptions. Most living historical farms find long-term preservation of old varieties of crops and rare breeds of livestock difficult if not impossible (28). Because no tradition of plant curation and animal breeding exists, directors at many institutions are not particularly interested. Even committed institutions face problems including limited budgets, lack of expertise, and staff shortages and turnovers. Although these factors limit the potential of most living historical farms for long-term germplasm maintenance, they have greater potential in raising public interest, understanding, and concern about the importance of biological diversity to agriculture.

Preservation of Agricultural Animals

Concern for conserving domestic animal germplasm stems largely from the knowlege that production and market conditions can change. Genotypes lost in the past may, in fact, be the very ones most suited for future environments or markets. The potential to transfer genes between species using genetic engineering is another reason for conserving rare and unusual genomes so they will be available for future use (22). More esoteric rationales for conserving threatened breeds of livestock include their intrinsic, cultural, and historic values.

While extinction of domesticated animal species is unlikely, the loss of specific genes or genotypes is occurring. This loss of biological diversity usually happens when particular breeds or strains are dropped from the commercial mainstream or do not have obvious economic value. The U.S. animal agricultural system concentrates on modern breeds and management techniques because its primary concern is improved food production. Yet failure to maintain old or unusual breeds reduces the genetic diversity of animal germplasm (15,26).

An estimated 60 to 100 minor breeds of sheep, cattle, pigs, horses, and goats exist in the United States. None are indigenous to this country, but some are now extinct in their country of origin. Others have the same name as foreign breeds but, through years of separate selection by humans and the environment, have developed into quite different strains. Still others are

unique combinations created in and restricted to the United States (26).

Despite a recognition that sampling, evaluating, preserving, and using exotic and endangered sources of domesticated animal germplasm would be in the national interest, no organized program currently exists, either in the United States or internationally (15,74). Commercial breeding companies and, to a greater extent, artificial insemination companies do preserve some animal germplasm, but neither have significant programs, particularly for the maintenance of living collections of minor breeds of livestock.

The purpose of this section is to report on contributions of individuals, breed associations, and network organizations in maintaining the biological diversity of domesticated animal species in the United States. More specifically, it examines grassroots activities which, for various reasons, maintain living collections of so-called minor breeds—agricultural animals that are not commercial at this time.

Individual Animal Breeders

Individual breeders maintain most of the minor breeds in the United States. Various circumstances and motivations have allowed them to perpetuate these breeds despite pressures to replace or crossbreed stocks with modern, more productive strains. Many minor breeds are maintained by a dwindling number of old-fashioned farmers and breeders who never made the capital investment to replace their stock or who maintain a breed because its qualities are well suited to their lower inputs and management practices. In a few cases a breeder may find or develop a specialty market for a product derived from a rare breed. Yet others may maintain minor breeds as a hobby or to show competitively. Finally, a few breeders maintain a particular rare breed at their own expense because they are concerned about its long-term survival of a particular breed.

R. M. Holliday.—Although agriculture has developed rapidly in the past 40 years, many people still farm in traditional ways with breeds of livestock they have always used. These people are, in effect, maintaining a resource, often without realizing it and seldom with any encouragement or support. The number of old-fashioned breeders and the minority breeds they are preserving are dwindling under commercial pressure and USDA recommendations to replace or crossbreed these stocks with modern, more productive strains (26).

Mulefoot hog breeders are a typical case. The mulefoot is a large (males weigh 600 lbs), normally black, hairy pig. The hog is known for its mild temperament, superior mothering ability, and its ability to thrive outdoors. Its unique characteristic is a single, fused toe on each foot, rather than the normal cloven hoof. Some breeders feel that this characteristic could solve the problem of splayed feet typical of hogs which are raised in enclosures with concrete floors. In 1910, 235 breeders were registered in 22 States by two separate Mulefoot Hog Associations. Because the hogs do not thrive under intensive confinement management with high protein diets, their numbers dwindled. The last breed association dissolved 8 years ago and today, the only major breeder is R.M. Holliday of Louisiana, Missouri (28).

Holliday, whose family has maintained mulefoot hogs for over 75 years, rears at least 300 market pigs a year. He keeps his own breeding

Photo credit: American Minor Breeds Conservancy

Mule-footed hog, a minor livestock breed notable for its single-fused toe on each foot

records and, until recently, sold breeding stocks to interested farmers. For various reasons, including costs associated with selling pigs in other States (veterinary certification and other paperwork costing on the order of $50 per pig), Holliday has been forced to restrict his operations to the production of pigs for the local meat market (28). The survival of this hog breed largely depends on the determination of one man, now in his late sixties.

I. Painter.—A small number of people in the United States are committed to the concept of rare breed conservation per se and are prepared to maintain those stocks even in the face of reduced income. One example is Ingrid Painter of Seattle, Washington, who is working to conserve the old type Navajo sheep.

Descended from the Churro sheep introduced by the Spanish in the early 1600s, the Navajo sheep is highly adapted to the climatic extremes on the Navajo reservation. Its wool is used to produce Navaho rugs, a major source of cash income for the reservation. To improve carcass quality and salability of wool produced on the reservation, State and Federal extension agents on the reservation have since 1883 encouraged the use of short wool meat sheep to replace the Navajo sheep. Consequently, less than 500 old-type Navajo sheep remain, mostly in the most remote areas of the reservation. A small conservation program for the "old-type Navajos" is run by Utah State University, but otherwise the survival of the breed is dependent on enthusiasts such as Ingrid Painter.

Because of her interest in American weaving, particularly that of the Navajo Indians, Ms. Painter purchased some old-type Navajo sheep in 1974 and has since been collecting good examples of the breed ever since. She has published a small book on the breed; produces a regular newsletter which circulates to over 400 interested people; and gives lectures on the breed as well as Navajo weaving techniques.

Ms. Painter's efforts illustrate how the motivation and expertise of an individual could be enlisted to conserve important minor breeds of livestock in the United States. Individual efforts, however, often are financially unstable and otherwise vulnerable. To be effective, such contributions need to be identified, monitored, and encouraged. Efforts to date have been inadequate.

Photo credit: American Minor Breeds Conservancy

Four-horned ram of the old-type Navajo sheep. This now rare breed was once used extensively by Navajo Indians because of its adaptation to climatic extremes on the reservation

Animal Breed Associations

Breed associations are unions of farmers who maintain and produce the same pure breed. They provide pedigree registration and certification services to their members, and they promote and market their breed commercially. Ordinarily, breed associations try to improve their stock by encouraging selective breeding which, by definition, removes "less desirable" genotypes from the population and gradually reduces the genetic variation within the breed. As a re-

sult, breed promotion and breed improvement can be detrimental to the maintenance of genetic diversity. However, if every breed has an association and their standards and proposed characteristics differ, the combined efforts of breed associations could contribute to conserving genetic diversity (28).

Alternatively, one breed may dominate markets, forcing others out. The most notable example is in the American dairy industry. Current pricing policies for dairy products favor low milk-solids content. Holstein cattle, having superior whole-milk production per cow, accounted for 79 percent (in 1981) of all U.S. dairy cattle registrations (29), despite the fact that their high production requires high levels of concentrated feeding (15). With efficient sire selection, artificial insemination, and embryo transfer programs, the Holstein Association will probably continue to acquire a greater proportion of the market at the expense of other breeds and the national pool of genetic variation in dairy cattle (28).

The associations of the declining breeds (e.g., the Jersey, Guernsey, Ayshire, and others), in fighting for their share of the market, are working to conserve biological diversity. These associations keep breeders in touch with one another, record pedigree information that can prevent serious inbreeding in small populations, and promote the breed in a number of ways (28). Active associations are important for the survival of minor breeds, but they are dependent on member contributions and, in the case of small associations, are frequently member-run. Consequently, a small group of breeders that really needs the support of an association to promote their breed may not be able to sustain one (16).

The tenuous dependence of a minor breed on its breed association is illustrated by the American Cream Draft Horse Association. Developed in Iowa in the early 1900s, the American Cream is related to the American Belgian and is the only draft horse breed developed in America. It gained popularity in the Midwest during the 1930s through the 1950s, and teams were regularly shown at midwestern fairs (27). A breed association started in 1935 but by the 1960s horses were no longer a primary source of power, and the larger herds disappeared along with the farming breeders. Activity in the association nearly ceased, although the registration service remained open if unused. The secretary of the association convinced that the breed was doomed to extinction, made plans in the mid-1970s to give all of the association's records to the Iowa State University library so that at least its history would survive (27).

A small group of breeders reestablished the American Cream Draft Horse Association in early 1983. Among them they maintain 28 purebred mares and 6 stallions. Of the four major breeders, three are in their sixties and only one still works his farm with the breed. Although the association maintains the records necessary to avoid the problems of inbreeding, it has little money to advertise the breed. Even if a market could be generated, it is unlikely that these breeders could accommodate it. In the absence of semen storage and distribution facilities, mares sold to new buyers without access to American Cream Draft stallions, in effect, are lost to the breed (27).

The American Cream Draft Horse is typical of numerous minor breeds that owe their existence to the officers and members of a breed association. The case of the American Cream Draft Horse Association demonstrates how their activities can contribute to the preservation of diversity, even though most breed associations do not consider the conservation of diversity as one of their major goals. Paradoxically, the most threatened breeds are the least likely to have a breed association capable of protecting and promoting them.

American Minor Breeds Conservancy

Improved networking will be necessary to capitalize on the scattered contributions of the numerous grassroots individuals and associations currently maintaining U.S. living collections of minor breeds. Such activities, to date, are few and seldom focused on maintaining biological diversity. The one exception is the American Minor Breeds Conservancy (AMBC), the

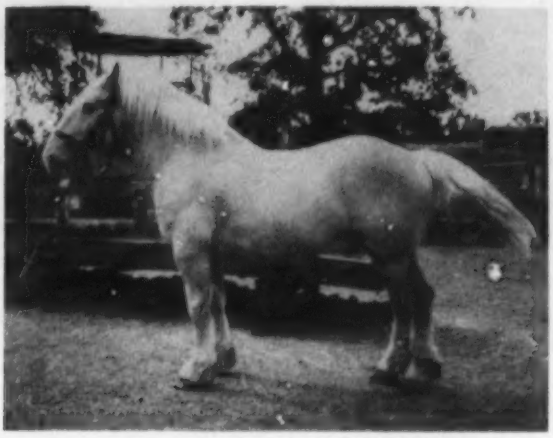


Photo credit: American Minor Breeds Conservancy

American Cream Draft Horse. The only breed of draft horse developed in the United States

only network organization in North America whose primary goal is conserving rare domestic breeds of livestock.

AMBC was established in 1977 as a small organization run by volunteers. Initially, no animal breeders were involved. A 1981 article, published in the popular press, focused national attention on the organization and prompted interest from breeders' groups. Although AMBC is still not financially secure, it recently received modest outside funding which allowed it to hire a full-time project director and an administrative assistant (63).

The organization launched the AMBC Rare Breeds Rescue Project (RBRP) in the spring of 1985 to survey minor domestic and feral breeds in the United States. The project also plans to establish a national network system for registration and referral of stock, as well as breeding, and research activities in minor breeds (28). Plans for the RBRP include four main elements (62):

1. Assess the current status of rare breeds, including publication of the first "endangered species list" of farm animal breeds. This information base will allow AMBC to set priorities for its rescue and preservation efforts.
2. Promote rare and endangered breeds by focusing national attention on those most severely threatened. Interested farmers and potential breeders will be able to locate sources of breeding stock through AMBC.
3. Facilitate preservation of breeds by stimulating discussion between breeders, encouraging formation of breed associations, and providing technical help and advice to existing breed associations.
4. Establish a computerized registry for all breeds without an active registry. The project also will help existing registries identify and locate unrelated breeding lines.

Although these coordinating activities could have great value, they are unlikely to be accomplished by an organization as underfunded and understaffed as AMBC. However, the establishment of a National Animal Genetic Resources Board, as has already been proposed elsewhere (15,74) could provide the national support, expertise, and direction such an organization needs. What SSE (see p. 36) has done for vegetables, AMBC could do for livestock by becoming an intermediary between individuals maintaining living collections of endangered livestock and a national program conserving animal genetic resources.

Although frozen storage of gametes and embryos of agricultural livestock is preferable to maintaining living collections for both genetic and economic reasons (65,66), there are biological and cultural reasons for maintaining living collections of minor breeds of livestock. For one thing, frozen storage cannot currently be applied to all livestock (22). Since a Federal program to maintain living collections of all minor breeds in the United States is unlikely, preserving this diversity depends on the activities of grassroots individuals, groups, and networks like AMBC.

Chapter 3

Summary Findings

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The level of grassroots activities has increased in recent years, in part because of increased public interest in environmental issues in general and because of concern over the loss of biological diversity in particular. Not only are more individuals becoming involved and new groups being formed, but existing institutions, such as botanical gardens and arboreta, zoos, and living historical farms, are redefining their activities so they contribute more to national efforts to maintain biological diversity. The activities of grassroots groups have become increasingly sophisticated largely because of network organizations like those highlighted in this background paper which coordinate member programs and consolidate the collective contributions of a disparate sector.

The variations in size and scope of grassroots activities make it difficult to generalize about how they contribute to the maintenance of biological diversity. The characteristics that fuel one organization's vitality or limit its effectiveness may be inconsequential in other organizations. Even within the categories defined in the preceding chapters, analysis is complicated by overlapping functions, varying goals, and differing motivations. Nonetheless, considered as a whole, grassroots efforts preserve a remarkably broad range of diversity in agricultural crops and livestock, wild species, and ecosystems. These contributions have been made at little direct cost to government.

The following are a number of general conclusions about the characteristics, constraints, and opportunities of grassroots groups maintaining biological diversity in the United States.

1. **Grassroots activities are a vital part of U.S. efforts to maintain biological diversity. They supplement those efforts by undertaking activities for which they are uniquely suited or especially willing, but they are unable to replace government's broader responsibilities for maintaining biological diversity.**

Grassroots individuals and organizations make a genuine contribution to the national effort to maintain biological diversity. Frequently, they undertake activities that Federal or State agencies for a variety of reasons cannot or do not address. In other cases, they complement government activities.

The efforts of grassroots groups to protect the habitats of particular species and preserve areas, which are ecologically or historically unique, may expand existing government reserves or protect sites outside those designated areas. The local nature of grassroots groups frequently allows them to negotiate more effectively than the government for lands to be integrated into existing National and State parks or reserves. Some groups also work to preserve Federal multiple-use lands by having them designated as congressionally mandated wilderness areas. Others actually acquire and manage land, such as the Bicentennial Prairie preserved by the Prairie Preservation Society of Ogle County and the wildlife sanctuaries maintained by the Florida Audubon Society.

Some grassroots groups monitor activities on government-owned lands and stimulate public debate on the fate of certain areas. Their most important contribution, perhaps, is in attracting attention to local or regional areas and issues which might otherwise be neglected by National and State agencies or large national conservation organizations. Although their efforts may bring them into conflict with Federal agencies and other private interests, they serve a useful role by raising issues and providing information to policymakers and the public. Effective grassroots groups, however, are not found in all regions, so important issues may be overlooked.

Some rare plants and animals become endangered when they are exploited in the wild. Although the United States has laws and statutes that restrict their exploitation in this country, these government efforts can be supplemented

by grassroots groups, particularly when local populations are endangered. A more complex situation arises when rare or endangered plants or animals are exploited outside national boundaries and imported to collectors inside the United States. While international agreements, such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) restrict such traffic, enforcement can be difficult. Grassroots groups cannot eliminate these problems, but groups such as the American Federation of Aviculture have instituted guidelines to discourage their members from purchasing illegally imported species.

Grassroots organizations as a whole play a major role in raising general public awareness and concern about the loss of biological diversity. In this way, they increase the constituency for government programs responsible for maintaining natural areas as well as those collecting and safeguarding genetic resources for current and future generations. Educational activities range from general circulation of publications on issues related to maintenance of biological diversity, to exhibits in zoos, botanical institutions, and living historical farms. In addition, environmental education groups such as the Wildlife Education Program for a Living Future have created educational packets that make it easier for schools to integrate an ecology into their curricula.

Grassroots groups depend on membership support, and thus tend to devote most of their attention to organisms or areas with high public recognition or appeal. Most endangered organisms, however, lack the esthetic qualities to generate this sort of attention. Accordingly, primary responsibility for protecting the broad array of threatened species or ecosystems, including those that are less charismatic continues to rest with those government agencies mandated to do so.

Many grassroots groups are maintaining living collections of plants and animals not found in the Federal programs. This is an important function since the cost of expanding existing programs or establishing new ones to incorporate all the material maintained by grassroots groups would be prohibitive. Even materials which duplicate those in national collections provide important backup in case of catastrophic loss in national germplasm centers. In this regard, grassroots activities are, for the most part, a supplement of little or no cost to government programs.

2. The strength of grassroots organizations lies in a shared commitment to preserve resources which are perceived as valuable and threatened. The local focus and flexibility of many grassroots groups can make them particularly responsive to many issues. These organizations, however, can be vulnerable due to limited or unstable funding, and dependence on the enthusiasm of a single individual or small group.

Individuals engaged in grassroots activities usually are motivated by a personal determination to preserve a resource they perceive as threatened. Groups generally are united by a shared desire to protect a local area or a particular group of plants or animals for which they have a special interest or concern. In many cases, they believe that the resource would be lost without their intervention. Grassroots groups define their own goals and methods. They typically lack the bureaucracy of government agencies or larger national organizations so they can respond quickly and creatively when the resources are threatened.

Because they are geographically close to and intimately familiar with the places or species they protect, grassroots groups are frequently the first to observe trends and articulate needs (45). As part of the local community, grassroots groups often have extensive knowledge of local species or areas as well as greater insights into local interests and concerns. As a result, they may be better able to define their activities to reflect issues of greatest concern to local residents or, at least, are able to define how best to approach local residents on issues they feel need attention.

Locally based grassroots groups often possess a keen understanding of local laws and ordinances. Members may also have close personal contact with local officials so they are better able to attract the attention necessary to achieve their

goals. On the other hand, when they are pitted against larger and more powerful interests, local groups can be constrained by their lack of political clout and legal or scientific expertise. Some are able, however, to secure *pro bono publica* assistance from attorneys and scientists. In some situations, their small size combined with what are frequently perceived to be altruistic motives, can work to their advantage, providing them with greater leverage than would ordinarily be predicted by their size (45).

Funding is the major constraint for nearly all grassroots activities. Many individuals support their efforts with personal resources. Organizations usually obtain operating funds from membership dues, fees, sale of materials, and donations. Because they want to involve as many people as possible, groups frequently are reluctant to increase their funding by raising dues. Several groups depend heavily on grants from charitable foundations or, occasionally, industry. However, many grassroots groups may lack the expertise, inclination, or time to seek such funding. The volunteers in these groups would generally rather devote their energies to actually preserving or protecting agricultural crops or livestock, wild species, or ecosystems than preparing lengthy documents; proposal preparation usually is restricted to those groups with paid staff.

Many grassroots groups depend largely on the enthusiasm and contributions of volunteer members. Grassroots projects can be particularly vulnerable when the organization depends on one or a few individuals. Although this constraint is, to some extent, built into the nature of volunteer grassroots groups, some organizations have tried to overcome it. The Rhododendron Species Foundation is working to ensure its long-term survival by developing endowments which would fund their daily operations. Organizations that are sponsored by other smaller groups, such as the Southeast Alaska Conservation Council and the Greater Yellowstone Coalition, do not concentrate leadership responsibility into one or a few people and are, thus, more easily able to replace key individuals. Institutionalizing their activities would be difficult, however, for many groups and it might reduce the vitality of their efforts.

3. Federal and State laws, policies, and actions can have a considerable positive and negative impact on the effectiveness of grassroots groups.

Most of the activities highlighted in this background paper maintain biological diversity with little or no direct government subsidy. These groups frequently serve the public interest at their own expense without expecting reimbursement. However, government laws and policies can inadvertently constrain the efforts of individuals and groups. Conversely, greater government recognition or support could provide both encouragement and stability, in many cases, at minimal expense.

The individuals active in grassroots organizations are usually volunteers. The organizations depend on members and other interested individuals to donate funds, equipment, facilities, and even land to accomplish their goals. The tax deductible status of most grassroots groups is an important device for attracting support. With mounting concerns over Federal budget deficits, charitable contributions are coming under greater scrutiny. Should charitable deductions be reduced or eliminated, donations—a major source of funding—might be seriously curtailed.

Another legal mechanism used extensively by many land preservation groups is the conservation easement. However, tax laws on deductions for such easements are vague, and some local Internal Revenue Service offices have adopted policies which discourage such donations. The frequently complex issues surrounding land donation and acquisition present major obstacles to groups lacking legal expertise. Although the Land Trust Exchange helps grassroots groups address many of the legal questions involved in land acquisition, clarification of the issues, particularly those surrounding conservation easements, could facilitate these efforts.

Federal policies and programs maintaining diversity of plant and animal germplasm vary considerably. Perhaps best defined is the National Plant Germplasm System, which is responsible for collecting, evaluating, and storing agricultural crops and their wild relatives. A number of grassroots groups supplement the

Federal program by maintaining heirloom and endangered commercial varieties of vegetables including many which are not contained in existing national collections. To date, these grassroots activities have received little recognition, and minimal effort has been made to incorporate their materials into the national system. Increased cooperation between these groups could not only strengthen these grassroots efforts but also improve the national collections of crop germplasm. Among other things, representatives of grassroots groups could be enlisted to participate in national plant germplasm advisory committees.

The Federal Government has no formal program to sample, evaluate, and preserve endangered sources of domesticated animal germplasm. However, several grassroots programs maintain living collections of various rare breeds of livestock. The value of these efforts to maintain diversity among minor livestock breeds would be greatly enhanced by establishing a Federal program which could provide direction, technical expertise, and support for these grassroots efforts.

Finally, the effectiveness of grassroots activities could be enhanced through greater assistance from State and Federal agencies in areas that require technical expertise, such as plant or animal breeding or germplasm storage. The expense and expertise required by sophisticated technology put it beyond the reach of most groups and individuals. Although larger botanical gardens, arboreta, and zoos are technically sophisticated, their conservation role is relatively recent and limited, so far, to a few institutions. For smaller groups, appropriate technology is essential. The Seed Savers Exchange, for example, has sought assistance from outside experts in developing simple seed propagation and storage methods which could be used effectively by gardeners who want to preserve seed.

4. Network organizations that coordinate the activities of individuals and small grassroots groups can enhance the contributions to the maintenance of biological diversity.

This background paper has described several organizations that coordinate the efforts of individuals and small grassroots groups. Such network groups overcome many of the constraints described in the previous section by pooling resources, experience, and expertise. They can elicit broader support by defining goals that go beyond the narrow objectives of individuals or local groups. They also can function as intermediaries articulating the concerns of their constituencies to government agencies and decisionmakers.

Network organizations can reduce the vulnerability of rare or endangered plants and animals being maintained by individual collectors. Groups such as the Seed Savers Exchange, the American Federation of Aviculture, North American Fruit Explorers, and the American Minor Breeds Conservancy identify and coordinate the activities of individuals who maintain collections of rare plants or animals. In so doing, they reduce the chances that a collection will be lost if a member, for whatever reason, is no longer able or willing to maintain it. They also reduce vulnerability by encouraging other individuals to become involved in maintaining collections.

Many grassroots groups confront technical or legal problems for which they lack expertise. By allowing them to benefit from the experiences of others with similar interests and problems, network organizations provide technical expertise that might otherwise be unaffordable. The Land Trust Exchange, for example, provides legal information to the land trust community at minimal cost. Networks also can address technical problems such as proper genetic management of captive populations. The Center for Plant Conservation and the American Association of Zoological Parks and Aquariums both set standards and priorities to maximize the use of limited resources.

The technical problems are particularly acute with off-site maintenance of animal germplasm. Most grassroots activities must maintain living collections for a variety of reasons; for example, they cannot use sophisticated propagation or

storage technologies such as cryopreservation of semen or embryos. Grassroots efforts also are criticized because they do not have the breeding expertise necessary to maintain genetic diversity and stability. Even large efforts, such as Texas Game Ranching may inadvertently breed animals so genetically adapted to their new homes that re-introduction to native habitats is impossible. The grassroots community has addressed such problems in part by establishing breed registries and obtaining professional advice through network organizations.

The specific goals of many grassroots groups would receive a more attentive hearing if their connection to larger issues were explained. However, the local focus of many individuals and groups makes it difficult for them to relate their activities to larger national or regional issues. By combining their efforts, such groups can achieve a broader perspective and consequently may accomplish far more than they could individually. The Greater Yellowstone Coalition, for example, unifies the efforts of many groups in a broad region by identifying larger goals and allowing constituent groups to define their interests and potential contributions within that context. Such coordination is essential in conserving large regional sites which are governed by many jurisdictions. The benefits of such cooperation also are evident in the current campaign to coordinate the cleanup of the Chesapeake Bay.

Network organizations also express their constituents' concerns to government. Through lack of expertise or funds, small local groups frequently have difficulty conveying their concerns to decisionmaking officials. Groups with broad recognition, such as the Florida Audubon Society, perform a dual function. First, they help local chapters define local issues; then the network can intercede for them at the State level when necessary. Similarly, the Southeast Alaska Conservation Council provides technical assistance to its constituent groups and gives them a stronger voice with the Federal Government and the U.S. Forest Service by incorporating their concerns to its overall plans for the region.

The grassroots networks described in this background paper demonstrate how much can be accomplished on very limited resources. The publications they produce are primarily intended to improve their own capabilities but are often of great value to others including government agencies. Notable is the *Garden Seed Inventory* published by the Seed Savers Exchange which identifies threatened commercial varieties of vegetables. The inventory allows seed companies to determine when they are the sole source for a variety, and also could be used by the National Plant Germplasm System to identify commercial varieties to be stored by the National Seed Storage Laboratory. Recent efforts by the American Minor Breeds Conservancy to keep track of rare livestock breeds being maintained by individuals and breed associations could become a similar early warning system that would alert scientists and others to the imminent extinction of specific breeds.

The Federal Government could enhance the effectiveness and reduce the vulnerability of these networks through greater support, including resources, technical assistance, and in some cases, simple encouragement and recognition. Increased communication between grassroots networks and Federal and State agencies also could help identify areas where these sectors could cooperate for mutual benefit. Some of these grassroots networks in effect subsidize government responsibilities; and Federal or State governments could consider supporting such projects accordingly.

Appendixes

Appendix A
Acronyms

AAZPA	—American Association of Zoological Parks and Aquariums
AFA	—American Federation of Aviculture
ALHFAM	—Association of Living Historical Farms and Agricultural Museums
AMBC	—American Minor Breeds Conservancy
ANILCA	—Alaska National Interests Lands Conservation Act
BLM	—Bureau of Land Management, U.S. Department of the Interior
CAST	—Council for Agricultural Science and Technology
CITES	—Convention on International Trade in Endangered Species of Wild Fauna and Flora
DTNA	—Desert Tortoise Research Natural Area
FAS	—Florida Audubon Society
FWS	—Fish and Wildlife Service, U.S. Department of the Interior
GYC	—Greater Yellowstone Coalition
IBPGR	—International Board for Plant Genetic Resources
NAFEX	—North American Fruit Explorers
NAS	—National Audubon Society
Native Seeds/SEARCH	—Native Seeds/Southwestern Endangered Aridland Resource Clearing House
NCF	—National Colonial Farm.
NFMA	—National Forest Management Act
NPGS	—National Plant Germplasm System
NSSL	—National Seed Storage Laboratory
OES	—Office of Endangered Species, U.S. Fish and Wildlife Service
OTA	—Office of Technology Assessment, U.S. Congress
PPOCI	—Prairie Preservation Society of Ogle County, Inc.
RBRP	—Rare Breeds Rescue Project
SEACC	—Southeast Alaska Conservation Council
SSE	—Seed Savers Exchange
SSP	—Species Survival Plans of the AAZPA
TLMP	—Tongass (National Forest, AK) Land Management Plan
USDA	—U.S. Department of Agriculture
WEPLF	—Wildlife Education Program for a Living Future
WPA/USA	—World Pheasant Association of the United States

Appendix B
Glossary

Agricultural variety: Modern crop or livestock variety or a locally adapted variety produced by breeders. These include older, heirloom varieties now replaced in cultivation practice.

Air-layering: Process of scraping the bark or outer surface of a stem, surrounding it with wet sphagnum moss, and wrapping the sphagnum in plastic to induce rooting.

Artificial insemination: Introduction of semen into the uterus or oviduct of an animal by other than natural means.

Biological diversity: The variety and variability within and among living organisms and the ecological complexes in which they occur.

Biome: A regional ecosystem type with similar communities of organisms.

Biota: The living organisms of a region.

Breed: A group of animals or plants related by descent from common ancestors and visibly similar in most characters. Taxonomically, a species can have numerous breeds.

Breeding line: Genetic lines of particular significance to plant or animal breeders that provide the basis for modern varieties.

Budding: A form of grafting in which a single vegetative bud is taken from one plant and inserted into stem tissue of another plant so that the two will grow together.

Centers of diversity: A region especially rich in the concentration of different plants. Generally associated with richness of species and genes.

Community: A group of ecologically related populations of various species of organisms occurring in a particular space and time.

Cryogenic: Involving the use of very low temperatures. For germplasm, it refers to the storage of genetic material (seeds, sperm, embryos) at or near the temperature of liquid nitrogen (−196° C).

Cultivar: International term denoting certain cultivated plants that are clearly distinguishable from others by one or more characteristics and that when reproduced retain their distinguishing characters. In the United States, "variety" is considered to be synonymous with cultivar (derived from "cultivated variety").

Cuttings: A plant piece (stem, leaf, or root) removed from a parent plant which is capable of developing into a new plant.

Ecosystem: An ecological community together with its physical environment, considered as a unit.

Espalier: A plant trained to grow against a flat support, as a wall or trellis.

Ex-situ: Pertaining to study, or maintenance of an organism or groups of organisms away from the place where they naturally occur. Commonly associated with collections of plants and animals in storage facilities, botanic gardens, or zoos.

Exotic species: An organism that exists in the free state in an area, but which is not native to that area. Alternately, refers to animals from outside the country in which they are held in captive or free-ranging populations.

Extinction: Disappearance of a taxonomic group of organisms from existence in all regions.

Extirpation: Disappearance of a form from existence in a local or regional area.

Feral: A domesticated species that has adapted to existence in the wild state, but that remains distinct from other wild species. Examples are the wild horses and burros of the West, and the wild goats and pigs of Hawaii.

Gamete: The sperm or unfertilized egg of animals that transmit the parental genetic information to offspring. In plants functionally equivalent structures are found in pollen and ovules.

Gene: A chemical unit of hereditary information which can be passed from one generation to another.

Genome: The genes which compose an organism. More specifically this refers to those genes found in the reproductive cells of an organism.

Genotype: The genetic constitution of an organism, as distinguished from its physical appearance.

Genus: A category of biological classification ranking between the family and the species, comprising structurally or phylogenetically related species or an isolated species exhibiting unusual characteristics.

Germplasm: An imprecise term generally used to refer to the genetic information of an organism or group of organisms.

Grafting: The technique of bringing the parts of two plants together such that they grow together, one deriving nutrients and growing from the other.

Grow-out: The process of growing a plant for the purpose of producing fresh, viable seed and to evaluate its varietal characteristics.

Habitat: The place or type of site where an organism naturally occurs.

Hardiness: Capability of survival under adverse

environmental conditions (e.g., cold or saline environments).

Heirloom: Generally refers to old varieties of crops, not found in general cultivation that have been handed down from one generation to another.

Hybrid: An offspring of a cross between two genetically unlike individuals.

Inbreeding: Mating between relatives.

Indigenous: Organism produced or living naturally in a specific environment.

Landrace: Primitive or antique varieties usually associated with traditional agriculture. Often highly adapted to local conditions.

Minor breed: A livestock breed not generally found in commercial production.

Native: A plant or animal indigenous to a particular locality.

Newcastle's disease: A destructive and highly contagious virus disease of birds that affects the respiratory and nervous systems.

Off-site: Maintenance or study of organisms away from an organism's native environment.

Old-growth forest: A mature forest stand growing on a site which has not been previously cut for timber production.

On-site: Maintenance or study of organisms within an organism's native environment.

Open-pollinated: Plants which are pollinated by physical or biological agents (e.g., wind, insects) and without human intervention or control.

Panmictic: Relating to the random mating within a breeding population.

Phenotype: The observable appearance of an organism, as determined by environmental and genetic influences (in contrast to genotype).

Population: A group of organisms (of the same species) occupying a specific geographic area.

Potted culture: Growing of a plant in a container.

Predator: An animal that obtains its food primarily by killing and consuming other animals.

Species: A taxonomic subdivision of the ranking genus and includes closely related, morphologically similar individuals that actually or potentially interbreed.

Taxon: A taxonomic group or entity (pl, taxa).

Taxonomy: A hierarchical system of classification of organisms which best reflects the totality of similarities and differences.

Variety: See *cultivar*.

Variety testing: Grow-out of a plant cultivar for the purpose of assessing its performance characteristics, such as production, disease resistance, and drought stress.

Wild relative: Plant species that are taxonomically related to crop species and serve as potential sources for genes in breeding of new varieties of those crops.

Wild species: An organism captive or living in the wild that has not been subject to breeding to alter it from its native state.

Wildlife: Living, nondomesticated animals.

Appendix C

Grassroots Workshop, Aug. 12, 1985

George Fell
Natural Lands Institute
Rockford, IL

Elizabeth Henson
American Minor Breeds Conservancy
Hardwick, MA

Hans Neuhauser
The Georgia Conservancy, Inc.
Savannah, GA

Edward Schmitt
Brookfield Zoo
Brookfield, IL

Jonathan Shaw
Bok Tower Gardens
Lake Wales, FL

Kent Whealy
Seed Savers Exchange
Decorah, IA

Appendix D
Commissioned Papers and Authors

Report on Grass Roots Genetic Conservation Efforts
Cary Fowler
Rural Advancement Fund

An Assessment of the Conservation of Animal Genetic Diversity at the Grassroot Level
Elizabeth Henson
American Minor Breeds Conservancy

Role of Grassroots Activities in the Maintenance of Biological Diversity: Living Plants Collection of North American Genetic Resources
Gary Nabhan and Kevin Dahl
Native Seeds/SEARCH

Grassroots Groups Conerned With In-Situ Preservation of Biological Diversity in the United States
Elliott Norse
The Ecological Society of America

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Office of Technology Assessment

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